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A Costly Lesson

A BIG price has already been paid by the United States, and incidentally by her allies, for a needless mistake on the part of the Administration. Until the affairs of the newly-created Shipping Board had become muddled to the point of scandal the Administration apparently failed to realize that men appointed to office from various walks of life for political reasons, and invested with authority by the Government, might prove wholly incapable of carrying out a vast industrial project in which the majority of them had had no experience whatsoever.

Who in private life, if entrusted with a large sum of money for building ships, would turn the management of the business over to a farmer, a lawyer, a lumberman and a railroad man with any expectation of success? And yet, as originally organized, only two members of the Shipping Board were men who had had any experience in shipping affairs. One of these, who has frequently been called the "dean of the steamship fraternity" in the United States, resigned from the board within a few hours after his appointment, because it immediately became apparent that politics rather than practical business considerations were to govern the board. His place was filled by a farmer whose knowledge of the sea, ships and shipping was apparently limited to the information given in the seal of his native State, which depicts an ancient vessel on the stocks.

Now that a general house-cleaning has taken place in the Shipping Board, and all but two of its original members have been dropped, would it not be natural to suppose that this costly lesson, involving weeks and months of delay in carrying out one of the most important functions of the Government in the present crisis, would be heeded and the control of the country's marine affairs be entrusted only to men who have proved by years of service and achievement in the marine field that they are capable of controlling and directing the marine affairs of the country? It is very much to be doubted if the Shipping Board can successfully fulfill its purpose, or if the full confidence of the country will rest in the Shipping Board, until it is composed of men who are the most capable and experienced men that the country can produce from its maritime industries. If the Shipping Board must build ships, why should not one of the best shipbuilders in the country be a member of the board? If the Shipping Board is to regulate the steamship companies and fix or regulate ocean rates, why should not at least two of the country's foremost steamship men be included in the membership of the Board?

In the interests of the nation and our allies we protest against further political appointments to the Shipping Board. Give us a Shipping Board that knows ships and shipping, Mr. President!

The New Government Shipbuilder

UNQUESTIONABLY the Shipping Board Emergency Fleet Corporation fared better than the Shipping Board itself in the recent change in administration. Rear Admiral Capps, who succeeds General Goethals as general manager of the corporation, and who will have charge of the vast programme of shipbuilding begun by his predecessor, is first of all a shipbuilder and a recognized authority in naval construction, with a long record of usefulness which speaks volumes for his ability.

Rear Admiral Capps held the important post of Chief Constructor of the United States Navy for two terms at a time when naval construction was undergoing important developments. How rapidly the United States Navy forged ahead during this period, not only in size and strength but especially in the development of types of vessels, for many of which Rear Admiral Capps was responsible, is a matter of history.

While Rear Admiral Capps is primarily a naval constructor, nevertheless, his interest in and knowledge of merchant shipbuilding are evidenced by the splendid service which he rendered as chairman of the most important committee at the recent International Conference on Safety of Life at Sea, held in London just before the war. Rear Admiral Capps' wide acquaintance in the shipbuilding field, with his intimate knowledge of both theoretical and practical shipbuilding, will at once inspire confidence in his ability to carry out the task which has been entrusted to him.

Training Engineers for the Merchant Marine

UNDER the direction of Prof. Edward F. Miller, head of the department of mechanical engineering at the Massachusetts Institute of Technology, Cambridge, Mass., a course of instruction for marine engineers, to meet the demand for officers to man the Government emergency fleet, was begun on July 9. Similar courses have also been instituted at the Stevens Institute of Technology, Hoboken, N. J.; the Johns Hopkins University, Baltimore, Md.; the Case School of Applied Science, Cleveland, Ohio; the Armour Institute, Chicago, Ill.; Washington University, Seattle, Wash., and Tulane University, New Orleans, La.

At the Massachusetts Institute of Technology the men report at 9 o'clock in the morning, and work at the school until 4 in the afternoon. During the morning members of the instructing staff deliver lectures on the various branches of marine engineering and the men are given an opportunity to write up the material which they obtain from the lecture. The entire afternoon is spent by the men in the laboratories of the school studying the con-

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struction and operation of engines, pumps and other machinery; they also have an opportunity to write up the experiments which they have performed in the laboratory. At the end of the course of instruction at the school students are given training on ships at sea under pay.

The minimum qualifications for entering the engineering schools are: (1) At least two years' experience as oiler or water tender, or combined experience of two years in these positions on ocean or coastwise vessels. (2) A graduate from the engineering class of a nautical schoolship. (3) A graduate in mechanical engineering from a duly recognized school of technology with three months' sea experience. (4) A stationary engineer in full charge of a 1,000-horsepower plant. (5) A locomotive engineer who has had six months' experience in the engine department of ocean or coastwise steam vessels. (6) A journeyman machinist who has been engaged in the construction or repair of marine steam engines. (7) An apprentice to the machinists' trade who has been six months on a steam vessel. (8) Engineers of lake, bay, sound or river steamers. (9) At least three years as a fireman on an ocean or coastwise steam vessel.

The Submarine Problem

OVERCOMING the German submarine menace is, without question, the most important individual problem of the war. To aid in solving this problem, there has been organized, as one of the co-ordinate branches of the National Research Council, an engineering committee, with offices in Washington and New York, which is in contact with the work of the other committees of the Council and with the various problems which are brought to its notice by the several branches of the government. The primary purpose of this committee is to act as an intermediary between the needs of the government on the one hand and the vast field of potential human energy and genius represented by the engineers of the United States. Prof. W. F. Durand, head of the department of mechanical engineering at Leland-Stanford University, and formerly head of the department of naval architecture at Cornell University, is vice-chairman in charge of this work, and under his direction an appeal has been issued to the leading engineers throughout the country, not only to devote their best thought and study to this problem, but also to transmit to the committee any suggestions which may give promise of effective service in dealing with any or all of the various phases of the problem.

Aid in this work may come from a great variety of sources, as undoubtedly the solution of the problem is manifold and may represent a joint application of many different elements under the general heads of: (1) Detection of the presence or location of a submarine, (2) protection against torpedo attack by the submarine, or (3) offense against the submarine. It is obvious, therefore, that the field for the application of scientific engineering effort in the solution of this problem is extremely diversified, and helpful aid may be furnished from a line of engineering work apparently unrelated to naval matters.

In order that the problem may be intelligently dealt with, however, certain facts regarding submarine warfare should be understood, and for this purpose the following memoranda furnished by the Engineering Committee of the National Research Council will be found of value:

Submarines operate singly or in groups, as may seem best suited to local or special conditions. They are supposed, where circumstances favor, to lie on the bottom at rest, and, with listening devices attempt to detect the approach of vessels. On receipt of evidence that a vessel is approaching, they rise to a level permitting observation with the periscope, and then maneuver accordingly. When in water too deep to permit lying on the bottom, a submarine must maintain steerage-way in order to hold its level of submergence. The minimum speed at which this can be done ranges from 2 to 4 knots.

The maximum depth of submergence of a submarine is about 200 feet, while the usual depth of running is from 50 to 100 feet. German submarines have been supposed to return to the home base at intervals of from 30 to 35 days. The total radius of action will presumably range from 5,000 to 8,000 miles at a moderate cruising speed of 10 to 12 knots. The high speed emerged will range from 14 to 18 knots, or possibly more in later designs. The maximum submerged speed is about 10 knots. The time required from emergence to submergence ranges from one to three or four minutes. When submerged near the surface, the time required to raise the periscope to take a quick observation and lower it again may range from 15 to 30 seconds. If desired, the submarine can follow an undulating path, rising and submerging alternately, or it may run fully submerged but near the surface and take frequent observations through the periscope. Modern submarines are provided with two or three periscopes, so that the loss or destruction of one will not necessarily disable the boat.

Torpedoes fired from the submarines are presumably aimed by changing the direction of the boat. This, however, is not assured in all cases. The torpedo, in order to run true, must travel at an immersion of about 10 feet. In smooth water it may run at a shallower depth than in rough water.

At night submarines may operate with less liability of detection, but with greater difficulty in picking up their target. Sounds produced by the movement of a submarine through the water, including those traceable to the propeller, to movements of the rudder, etc., should permit of detection by the use of modern refined sound-detecting devices.

Although one of the most common means proposed by laymen and others for the protection of merchant ships against torpedo attack is some form of shield or net outside the vessel, nevertheless naval constructors generally are satisfied that the distance at which protecting plates or shields would have to be placed in order to secure immunity against torpedo attack is so great as to render their use of very doubtful practicability. The distance at which a protecting net, plate, shield or other means of exploding the torpedo before reaching the side of the ship must be located in order that such distance will render the effect of the torpedo harmless will depend primarily upon (1) weight of explosive charge, (2) depth of torpedo when exploded, (3) strength of the ship's structure. With modern practice, a depth of 10 or 12 feet, and, with the structure of modern merchant ships, distances of 20 to 30 feet, would perhaps be required in order to give good assurances against injury. With rough water and possibly much less submergence at the time of explosion, reduced distances of 15 to 20 feet might prove sufficient.

Although the above facts are generally well known, the Engineering Committee of the National Research Council is ready to furnish additional information on specific points, if practicable to do so, to engineers or inventors who are investigating any phase of this question. Notwithstanding the great number of individuals and other agencies that have for some time been engaged in the study of this problem, there is urgent need of the very best efforts which American engineers can contribute to its solution.

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LETTERS TO THE EDITOR

American Shipping Should Be Subsidized

The July issue of MARINE ENGINEERING is of special interest in connection with the large number of new yards starting up and the question of the future of American shipbuilding. While I should like to feel sure that we will have a permanent shipbuilding industry in this country after the war ceases and matters settle back to normal, I cannot bring myself to believe that it will be a certainty unless the Government will at last pass a subsidy, which it most certainly should if it is going to maintain a high tariff.

When I read of the number of new yards being started almost daily, it seems as if the country had suddenly gone crazy on the subject of investing money in shipyard equipment, and I wonder if there is not going to be a serious reaction from it when peace is declared and the need for blockade runners has passed.

While Mr. Arthur F. Johnson may be right in his belief that we will be able to construct boats as cheaply as foreigners (which I doubt), how does he expect us to operate them under the American flag, and does he think that Europe will be liable to purchase many American-made boats at equal cost? I hope he is right, but apparently he entirely overlooks what I think is a most important question, namely, how can American capital own and operate boats in competition with foreigners without a subsidy when things return to normal conditions?

There is an enormous amount of capital now being invested in shipyards, and also, to my knowledge, in organizing for a large export trade, and it seems to me that it is to these capitalists we will have to look to wake up our Government and the farmers to a realization of the desirability, if not necessity, for such a subsidy as will assure a permanent merchant marine. The capitalists who are putting their money into shipyards and export companies might very well at the present time show some concerted opinion, indicating that they expect the Government and the people of the United States to pass a subsidy act which will insure the present investments they are making and which will provide our country with a merchant marine.

No longer can there be any doubt in the minds of anyone that an American merchant marine is a vital necessity as a protective measure in the event of war even if our farmers do not believe in it as necessary for the welfare of our country in international trade and world politics.

Hartford, Conn. N. L. SNOW,
Vice-President, Terry Steam Turbine Company.

Standard Ships and Standard Planning

A successful method by which results are predetermined in ships' construction will no doubt be quite usable at the present state of contemplated standard ship construction. Planning in advance, as all successful men of management know, is one of the necessary functions in the endeavor to reduce cost. Through the successful planning and routing of work, firms operating under the Taylor system and modifications of the Taylor system have attained business success—dividends. Through the acquisition of modern machinery, standard parts, bulk manufacture, interchangeable parts, and specialization, other firms have been successful—increased wages, better living conditions and lower priced products being the result of planning.

To apply the efficient methods of other industries is the problem which shipbuilding interests have been slow to acquire or attempt. That these methods are practical in all industrial activities and that results are assured any endeavors in this direction, can best be determined by the results obtained by F. W. Taylor, H. Emerson, H. L. Gantt, F. B. Gilbreth, their co-workers, and others.

With the present volume of standard ships to be built under the supervision of the Shipping Board standard planning offers results obtainable in no other way. If the ships are to be of one or a few types, the planning may be completed and used on all of each type of ship, slight changes being made as new and more economical methods are devised. A planning division handling these changes will immediately make any newly discovered methods known to all who are constructing this type vessels.

The planning offers further a check on all completed work, the percentage of completion and the status of

J O — DATE BEGIN WORK — COMPLETE

Specifications.—Construct bottom & side plating complete with butt straps, liners, etc. But not including plate fenders or angles connecting deck to shell plating.

OPER. NO.	OPER.	ALLOW.	UNITS	UNIT PRICE	NO. OF UNITS	TOTAL PRICE	DESCRIPTION OF WORK	BEGIN	COMP.
1	LO	0	Sq. Ft.	.01	2176	21.76	F Strake Plates		
16	PL	0	Holes	.001	9868	9.89	Parallel Liners in B Strake		
29	CK	0	Holes	.0018	11710	21.08	3/4" Holes		
35	BO	0	Holes	1.00	48	48.00	Bilge Plates		
40	RM	0	Holes	.004	7312	29.25	3/4" Side		
44			Plate	.75	8	6.00	Knuckled End Plates 8-D-1 & 8-D-10 (Day Work)		
46	Roll		Plate	1.00	16	16.00	Rolled Bilge Plates Square Body (Day Work)		
					Totals	107499	1141.30	$\frac{1141.30}{107499}$ = 0.0106, Unit Price	

Fig. 1

J O	OPER. NO.	ALLOW.	UNIT	UNIT PRICE	NO. OF UNITS	TOTAL PRICE	BOLTING-UP	BEGIN	COMP.
A-1	35	0	Plate	1.00	48	48.00	Bilge Plates		
A-1	25	0	Brack.	.80	44	2.20	Brackets		
A-1	10	0	Brace	.10	168	16.80	Angles in Trusses		
A-1	5	4	Bolt	.05	16	.80	Bolt Chain Pipe PC. No. 10		
"	7	4	Bolt	.05	32	1.60	Bolt & Pack Pad Eyes PC. No. 10		
					Totals	10684	599.75	$\frac{599.75}{10684}$ = 0.05613, Unit Price	

Fig. 2

each individual job order. As the planning gives the amount of work for each job order, curves may be made showing the desired state of completion at stated periods; if the actual completion percentage runs above or below this curve, the steps to adjust are known.

For cost keeping and accounting the ship will be divided into groups, classified according to material and supervision, as shell plating, decks, framing, bulkheads, shipwright work, joiner and electrical work, piping, engines, boilers, auxiliary machines, painting, deck covering, equipment and hull fittings. The groups would be further divided into subgroups or job orders. For example, piping groups would be divided into plumbing, ventilation, voice tubing, pumping and drainage, sounding and air, main and auxiliary steam, etc.

The job orders would be divided into operations as illustrated on Fig. 1, which covers the work included in the construction of bottom and side plating on Navy standard coal barges. Each operation on each job order is worked out on the sheet, the number of units determined and prices set before starting work, this being a function of planning section. The old method consisted of making a drawing and sending it to the yard, the results being more or less dependent on the experiences of draftsmen, who usually have no practical experience, and in

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most cases lack the knowledge of process work required to complete the developed plan. When operated with a planning section, the drawings are made and check print sent to planning section, the planning section being composed of the best mechanics available, who plan the work, noting necessary changes required on the drawing. These changes are based on: (1) the planners' knowledge of shop equipment; (2) the practical difficulties that present themselves in all work; (3) the most economical method of doing a piece of work; (4) the most suitable material for the purpose; (5) determining the most efficient and economical way, as two or more methods always exist for doing a piece of work. This procedure is a practical education to the draftsman, as in making the changes the practical difficulties which must be overcome are called to his attention.

After the work is planned according to job orders, as in Fig. 1, operation sheets are made, as Fig. 2. A sheet or sheets of this kind contains all the work for a single operation, as bolt-up, punch, countersink, plane, flange, furnace, cut-threads, bead, saw, paint, taper, etc. The operation sheets segregate the work under the various supervisors. A supervisor may be responsible for one or more operations, whereas a single job order may contain fifteen or more operations. The operation sheets further assist counters in locating work and checking off, the latter being done on cross section paper glued to right hand edge of sheet.

In making drawings an effort should be made to have work of not more than one job order on each plan, although it is permissible to have a job order covered by one or more plans.

The next consideration is "standard operation num- [illegible] s installed, the two- [illegible] tisfactory; with the [illegible] ith accounting ma- [illegible] as simplified; it is [illegible] number, job number or operation number in a very short time, with a small amount of work. The standard operations are indicated by four numerals, two numerals to the right being numerical shop designation, two to the left indicating operation. Accounting and cost work is simplified by indicating all accounts and subdivisions by numerals. In Fig. 1, under operation, these numerical symbols would appear.

The description of column headings in Fig. 1 will be given, although partially explanatory: operation number is the numerical number under a specific job order and may appear in any sequence, its purpose is with description of work to readily identify an operation on operation sheets. Operation is the kind of work to be performed and is designated by numerals as described in the foregoing paragraph. As a specific example, L O (laying out) would be No. .0712, which is operation No. 7, shop 12, laying out and templating division. P U (punching) would be 1613, which is operation No. 16, shop 13, punch shed. Allow ——. This is taken from piecework schedule and is an extra price allowed in addition to straight piecework; No. 1 covers overhead work; No. 2 covers beveled shapes, rolled or furnace work; No. 3, closed in compartment or corner work; No. 4, odd or scattered work, the cost of preparation being allowed. Accessibility, continuity and difficulty of units are also considered in setting piecework prices. Unit, unit price, number of units and total price columns require no explanation.

The operation sheet has but one column which differs from the job order sheet—i. e., operation column is replaced by job order number. This cross files operations, showing from which sheet they were taken.

For a riveting sheet worked out by this method see, "Scientific Studies Applied to Riveting," Marine Engineering, September, 1916.

Balboa, C. Z. William M. Kennedy.

Development of Inland Waterway Transportation

Transportation on inland waterways, which is so strongly urged by the Government at the present time, owing to the inadequacy of the railway systems for handling the enormous amount of traffic created by the preparations for war, can be developed only through the co-operation of the railroads. The attitude of the railroads toward water transportation has been such, however, that only low class commodities are water-borne, such as coal, lumber, iron ore, flour, bran, feed, cotton, etc., and it is significant that the rates on these commodities are too low to make water transportation solely dependent upon them a success except under very favorable conditions.

Commodities such as the foregoing, which are the only ones generally conceded by the public as fit for inland water transportation (an impression which has been carefully developed by the railroads), are carried by the railroads between St. Louis and New Orleans, a distance of 1,245 miles by water, at rates varying from $2 to $3 per ton. In order to move these commodities by water someone must absorb the cost of carrying them to or from the river front either by truck, hand or rail. On through freight the railroads may be willing to assume the switching charges, but, if the freight originates or is delivered at points on the river, the railroads cannot assume the switching charges, and these charges must be assumed by either the shipper, consignee or water carrier. If it is the water carrier, he will have to add it to his rates or he will have to deduct it from his profits. If the shipper or consignee pays these charges, he will have to add them to his water rates. This charge for trucking or switching or carrying, varying, of course, as to distance, averages 60 cents per ton for delivery and 60 cents per ton for receiving.

Another charge which water transportation must always face, except in the case of a very few commodities such as grain, is that of loading and unloading. Without taking into consideration the cost of the boat, its equipment and administration during the time of being loaded and unloaded, this loading and unloading of these commodities will average not less than 40 cents per ton for handling over the present inadequate river terminals.

There are thus fixed charges not effected by the carrier which amount to more than $2 per ton, which water carriers will have constantly to meet on all such commodities as those mentioned above, which, according to the railroads, or misguided supporters of water transportation, are the only commodities fit for water transportation. No water transportation company can ever be a success as long as it has to assume these charges, or, if these charges are not materially lessened.

There are three solutions to this condition. One is the expenditure of millions of dollars for the construction of perfect river terminals, making such terminals the only place of accumulation of freight, regardless of whether the transportation is to be by rail or water, so that the haul to and from the river front is eliminated, and the cost of loading and unloading at the terminals is brought to an absolute minimum.

The second solution is by the railroads increasing their rates on such commodities as are moved to-day at a loss

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to themselves; for instance, flour is moved between St. Louis and New Orleans for $2.80 rail rate over a rail distance of 700 miles or 3 mills per ton mile, equal to the average lowest charge on coal on the Lehigh railroad, which is the most economical railway coal carrier in America.

The third solution is to build boats which are equipped to carry better class commodities and give these the proper protection and speed of delivery necessary to carry these commodities.

It would take several months for the readjustment of all transportation rates, but it is possible for the railroads to give quicker relief by reducing their interior rates. For instance, from New Orleans to Memphis, a rail distance of 400 miles against a water distance of 800 miles, freight is carried by the railroads at far below the average charges, but from Memphis to an interior point at a distance of, say, 80 miles, a charge is made which is twice the cost for which they have carried the freight along the river over 400 miles; in other words, a tenfold higher rate. Let the railroads adjust such rates, and if they wish to hide, perhaps with honest intent, behind the defenses they have always made, that rates on shorter hauls cannot be proportionately less as compared with long hauls, because their terminal expenses remain practically the same and the density of the population might give them less freight per mile of rail, let them at least agree to charge nothing else but the actual cost of carrying between these short-haul points plus the fair average profits made on their freight in general.

There is still another way in which the railroads may assist water transportation. The Inland Navigation Company, which was formed for transportation service on the Mississippi River between St. Louis and New Orleans, and of which the writer is president, was organized with the idea that the solution of water transportation is in the carrying of first-class commodities. It was soon found, however, that for various reasons it was impossible to secure sufficient of this first-class freight in St. Louis alone. It was found necessary to go outside of this territory—for instance, to Chicago, Indianapolis, etc. The first class rate from Chicago to New Orleans is $22 per ton, if moved all rail. If it is carried via St. Louis over two connecting railroads—for instance, the Wabash and the Iron Mountain—then the Wabash gets for its portion of the haul $7.12 and the Iron Mountain for the haul between St. Louis and New Orleans gets $14.88. Now if the Wabash gives the freight to the inland Navigation Company in St. Louis, they keep out of this $22 the sum of $9.10 and allow the Inland Navigation Company $12.90. Thus the railroads take 28 percent more money at the expense of the water transportation service for actually less service.

From this $12.90 which remains, the water transportation company must make a reduction in order to get the shipper to agree to their routing, which involves a rehandling of the freight and a delay. The expected reduction is 20 percent of the total rail rate, or $4.40, with the result that out of the $22 the water transportation company gets only $8.50, where a competitive rail carrier between similar points gets $14.88.

In addition, the water transportation company has the obligation to load and unload, which the railroad does not have. Thus, out of the remaining $8.50, the water transportation company must set aside at least $2.50 for loading and unloading and drayage or switching charges, which finally leaves for carrying first class freight between St. Louis and New Orleans, out of the total of $22, only $6, as against the competing railroads' $14.88.

As the attitude of the railroads in regard to this matter is a direct violation of both the spirit and letter of the law, the case was brought before the Interstate Commerce Commission. After a year of delay the Interstate Commerce Commission finally reached a decision and ordered the railroads to make joint rates with the waterway transportation company. They specified, however, that the railroads maintain joint rates, which shall be no higher than those maintained by them with rail carriers between the same points. The railroads declared, however, that, although having been ordered by the Interstate Commerce Commission to make rates not higher than the all-rail rates, nevertheless they were not instructed to make lower rates. Therefore they refused to do so.

Therefore the last solution of the problem of water transportation is by the railroads abandoning this attitude entirely and making joint rates with the water transportation companies, which they can do without the least loss or cost to them. If they do this, they will not only assist existing water transportation, but they will have made it possible for many new water transportation companies to come into existence, make profits and serve their country.

JOHN H. BERNHARD,
President, Inland Transportation Company.
New York.

Further Remarks on Reduction Gears of Floating Frame Type

BY JOHN H. MACALPINE

My paper on "Marine Applications of Reduction Gears of Floating Frame Type," read before the Institution of Naval Architects this spring, and reprinted in large part in MARINE ENGINEERING for June, gave rise to considerable discussion and the request for additional information. The reply in the Transactions of the Institution will, of course, not appear for a considerable time, nor will it reach all the readers of MARINE ENGINEERING, hence I desire to offer the following additional remarks here:

The earlier floating frame gears, with the exception of U. S. collier *Neptune's* present gears, had comparatively low power constants. This constant was gradually raised as experience was gained, and I shall now give data of some of the more recent gears with higher constants, and of the *Neptune's* present gears.

The gears supplied to the following three firms were from the same patterns: (A) Eastman Kodak Company; (B) Federal Rubber Company; (C) Aluminum Company of America. Pinion 5 inches pitch circle diameter, 3,600 revolutions per minute; overload rating 1,250 kilowatts; normal rating, 1,000 kilowatts. Each drives a D. C. generator, for which, in what follows, I take the efficiency as 92 percent. The dates on which these units were put in service are as follows:

(A) April 4, 1914; works at seven-eighths of overload rating about 16 hours per day, 7 days per week. This gives a power constant of 3.54.

(B) April 12, 1915; works at 1,000 kilowatts usually with frequent overloads up to 1,250 kilowatts, for 24 hours per day and 7 days per week. This gives a power constant fluctuating between 3.24 and 4.05.

(C) November 1, 1914; works 12 to 16 hours per day, 6 days per week, at a fluctuating load up to 1,250 kilowatts. This gives a maximum power constant of 4.05.

Gears were supplied to (D) the Jacob Ruppert Brewing Company and (E) the Schoenhofen Brewing Company. Pinion 3.9 inches pitch circle diameter, 3,600 revolutions per minute; overload rating, 550 kilowatts. These run 24 hours per day in summer, for 6 days per week,

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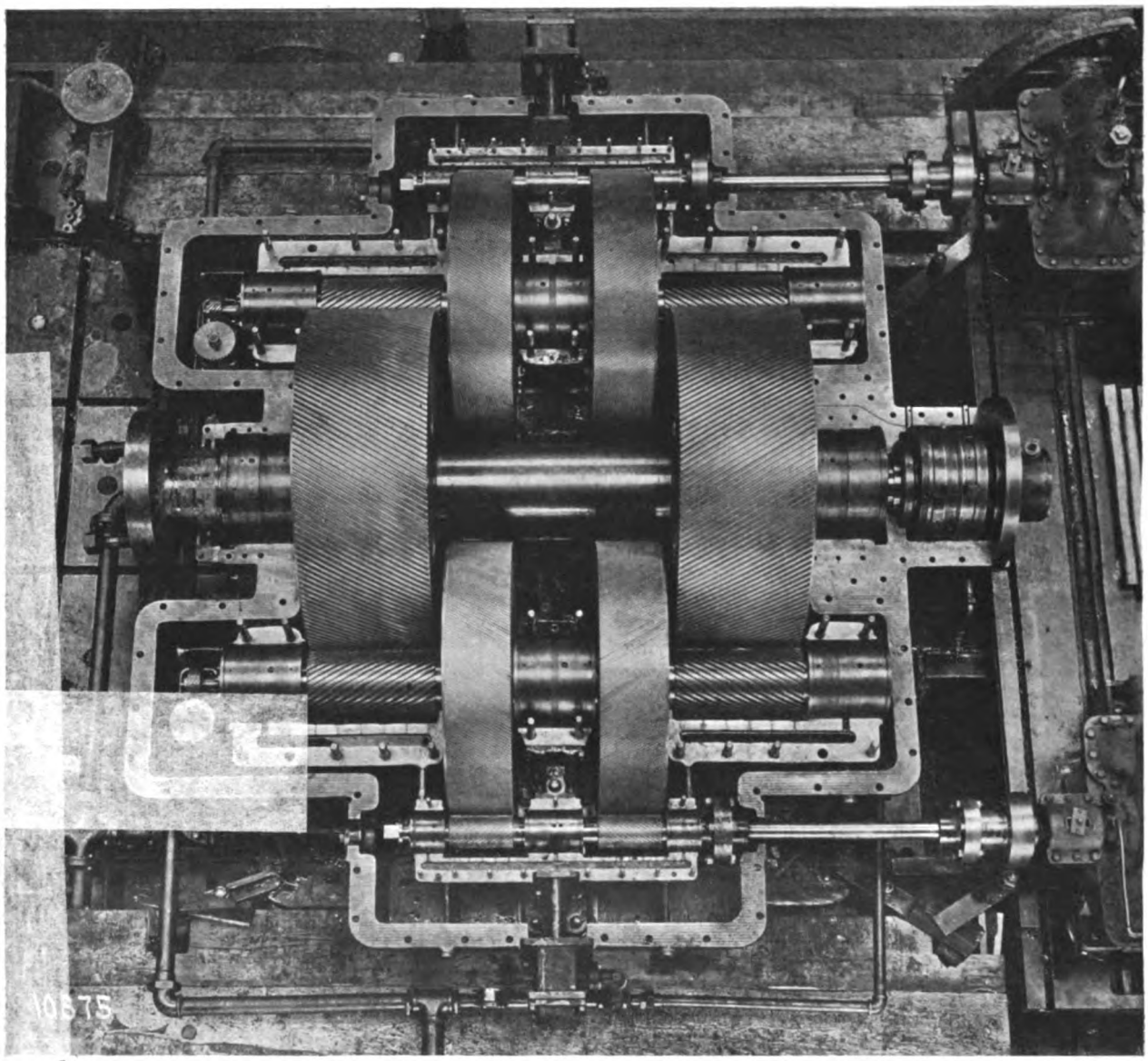

Double Reduction, Floating Frame Type Westinghouse Turbine Reduction Gear of 3,400 Horsepower. Speed Reduction, 3,740 to 72 Revolutions per Minute

at from 400 to 500 kilowatts. The power constant for [illegible] was put in service on June 5, [illegible] on August 14, 1914.

All these have given excellent service and are in perfect condition to-day; indeed, the same can be said of [illegible] which has been put in service, except the first gears of U. S. S. *Neptune*. These were replaced for no defect of the gears, but in replacing the turbines the revolutions per minute were much raised, requiring change of gear ratio.

U. S. S. *Neptune* has been in service since her official trials in November, 1915, at speeds from 12 knots to over 14. I am informed that there have been considerable periods at speeds which would give a power constant from 4.3 to 5.3. Her most continuous service has been in the last year and the log shows that between April 1, 1916, and March 31, 1917, she steamed about 40,000 miles. The speed for most of this distance was from 12 to 13 knots, which would give power constants from about 3.5 to 4.3. The gear teeth, examined a few days ago, are in excellent condition.

The present practice of the Westinghouse Machine Company is to make a power constant of 3.0 at normal load for gears driving electric generators, the value being kept a little low, as a short circuit greatly increases the stress for a short period; a value of 3.5 for merchant ships, as these may run frequently and for long periods at full speed, and a value of 4.0 for naval vessels.

It has been stated that rigid gears have been frequently designed for power constants about as high as those I gave in the foregoing paper. If so, either the data have not been published or I have overlooked it. In the "Table of Gear Data" (*Engineering*, Vol. CI, page 492) in my article "On Reduction Gears," I gave the three highest examples of power constants for marine rigid gears which I knew. These were:

(*a*) The *Vespasian*, power constant = 3. This is the highest result of a progressive trial trip and was of a few minutes' duration. The published data show that, for the average speed of the ship, the power constant is 1.85.

(*b*) Highest trial run of S. S. *Tuscania* gave 1.80; also of a few minutes' duration.

(*c*) Official measured mile trial results of S. S *Ciudad de Buenos Aires* and *Ciudad de Monte Video*, gave 2.58

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for the high pressure pinion and 1.29 for the low pressure. Values for land gears are usually lower than for marine gears.

Recent proposals seem to indicate that power constant for rigid gears shows no tendency to rise. They appear to fluctuate a great deal, suggesting trouble from the higher values.

Some think that I have overestimated the effect of minute errors of alinement of rigid gears, and that the teeth of such gears do bear evenly over their whole length. It was the conviction, arising from purely theoretical considerations, that minute errors of alinement would have serious effects, which gave rise to the invention of the floating frame. (See *Engineering,* Vol. LXXXVIII, page 378, Fig. 8, and text referring to it.) But this is no longer only a theoretical conclusion. The Westinghouse Machine Company have built both floating frame and rigid gears and know the great care which must be exercised to attain as perfect alinement as possible in the latter. The gear case, after being rough machined, is left till the internal stresses have relieved themselves as much as possible; still better results can be attained by annealing. The finishing cut is then made. No such precautions are necessary in building floating frame gears. Again, they found that the greatest care was necessary in bolting down the gear case; as predicted, the screwing down of a holding-down bolt could readily warp the casting and put the pinion and gear axes out of line. In small gears the difficulty can be largely met by bolting down the gear case at three points and keeping all the rest of the surface free. But this is not practical in large marine gears. Again, the high power constant which can safely be adopted in floating frame gears, as compared with those by the most experienced designers of fixed bearing gears, is convincing proof of the accuracy of this conclusion. As stated by Mr. J. A. Davies, engineer Marine Department, the Westinghouse Machine Company: "After an extended experience with gears of the fixed bearing type and those having pinion frames flexibly supported, we are unalterably of the opinion that the latter type of gearing, as described by Mr. Macalpine in his London *Engineering* articles (see *Engineering,* London, Vol. CI, page 415) is greatly to be preferred, even down to the smallest sizes."

It has been stated that examination of the teeth of some rigid gears has shown that they "bear evenly over their whole lengths." But, conclusive proof that gear teeth are bearing evenly over their whole length cannot be obtained by examination. If they have been bearing so hard at one part that they cut, the cutting will usually spread all along and little can be learned unless the gear is stopped very soon after this action starts. Examination will show if a portion of any tooth has not been bearing at all; but if there is bearing varying from a light pressure at one end of the tooth face to a heavy pressure but less than what will cause cutting at the other end of the face, the teeth will soon be brightened all over. It cannot even be concluded that the teeth are bearing all along at the same time, as working of the ship's bottom or any straining action may cause the bearing portion to change. As I stated in a letter recently (*Engineering,* Vol. CII, page 527): "When a grinder polishes a surface he only makes contact between the emery wheel and a small portion of the surface at one time." Improvement of pressure distribution cannot be made by giving the bearings ample clearance, as has been proposed. If a proper clearance is given, the oil film under pressure forms over a large arc of the journal. If this clearance is enlarged the effective arc is quickly restricted and the journal and brass come more nearly into contact. Further, no compensation of any value can be obtained through the oil film, for, as I showed in the recent letter just referred to, the thickness of the oil film is only very slightly responsive to change of total pressure from the journal. Besides, the change of bearing pressure which is supposed to alter the film thickness is due to bad distribution of tooth pressure. I need not rediscuss the question here. (In a footnote to that letter .0007 is printed instead of .00007; but as it is the difference of two numbers which are also given, this should cause no difficulty.)

The only way to insure uniform tooth loading is to reduce redundancy as much as possible; or, as Sir William E. Smith stated it in the discussion, in terms of the condition laid down by my old teacher, Sir William Thomson (Lord Kelvin), "unnecessary geometrical restraints should be avoided in all mechanical constructions." This the floating frame does. I must strongly contradict the statement which has been made that it is a complication; on the contrary, all the engineers of the Westinghouse Machine Company look on it as a great simplification of the construction and as making the proper action of the teeth a certainty.

Some criticisms seem to proceed on the assumption that the torsional error of the pinion is the most serious one. I have examined the various errors at great length in my article "On Reduction Gears," and have shown, and experience confirms, that the alinement error is far the most serious in rigid gears and that it does not exist in floating frame gears. Far after that comes the cross-bending error and torsional error, usually in the order named if the pinion has two bearings. If the pinion has three bearings, the order of importance of these two errors is reversed. The numerical investigation I have given shows that the tonsional error is so small that even were it obliterated the safe power constant would be only slightly raised. The anticipation recently made that a considerable reduction of the torsional error would allow the same power constant as for floating frame gears appears to me quite fanciful.

UNUSUAL PHOTOGRAPH OF REDUCTION GEAR WITH COVERS REMOVED

I show in the figure a very compact and light design of double reduction gear of which the Westinghouse Machine Company are now building a good many. A three-bearing floating frame supports each of the four pinions, and all the gearing is contained in one casing. The upper halves of all floating frames are removed, and it will be seen that the gears of each first reduction, which are solid with the pinions of the second reduction, are also carried in the floating frame. It is of 3,400 horsepower at 3,740 revolutions per minute of the first pinion. The weight, deducting the Kingsbury thrust block, the casing for which is cast on the gear case, is 34 tons. The overall dimensions in plan are 9 feet 8 inches fore and aft by 12 feet athwartship, giving 116 square feet. The foot bolting to the ship's keelson is 8 feet 6 inches by 10 feet 6 inches, giving 89.25 square feet. The reduction is from a turbine speed of 3,740 revolutions per minute to a propeller speed of 72 revolutions per minute.

In my paper before the Institution of Naval Architects (see MARINE ENGINEERING, June, page 260) the total horsepower of floating frame gears built and building is given as 738,169. This figure to-day stands at 1,183,764, which is a very satisfactory increase for the time, but contracts for the machinery for the merchant vessels which are to be built by the United States Shipping Board Emergency Fleet Corporation have not yet been let, and as soon as these contracts have finally been placed this figure will be vastly increased.

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Composite Cargo Steamer of 5,500 Tons for U. S. Shipping Board's Emergency Fleet

Designed by William B. Ferguson, President and General Manager Bayles Shipyard, Inc., Port Jefferson, Long Island, N. Y.

AS a logical sequence to the description given in our July issue of the 3,500-ton wooden cargo steamer designed by Theodore E. Ferris, naval architect, for the United States Shipping Board Emergency Fleet Corporation, we print herewith plans and extracts from the specifications of a larger vessel of composite construction, designed by William B. Ferguson, president and general manager of the Bayles Shipyard, Inc., Port Jefferson, Long Island, New York, for the Shipping Board fleet.

Bids for the construction of several vessels of this type have been submitted to the Shipping Board by this company, and in order to provide for this work, as well as for the carrying out of large private contracts, the Bayles shipyard has been increased by the acquisition of the Radel shipyards, also located at Port Jefferson. This gives the Bayles yard a total frontage of approximately [illegible] uipment three [illegible] shop and the [illegible] general manager [illegible] ose ideas the composite vessel has been designed, was formerly a naval constructor in the United States Navy and is a brother of Homer L. Ferguson, president of the Newport News Shipbuilding & Dry Dock Company, Newport News, Va. The other officers of the Bayles Company are as follows: Vice-president, H. P. Bope (also vice-president of the Carnegie Steel Corporation); treasurer, H. M. Williams; chief engineer, Bruce E. Loomis, and naval architect, S. C. Weston.

The principal dimensions of the ship are as follows:

Length overall	357 feet 6 inches
Length between perpendiculars	340 feet
Beam, molded	47 feet
Beam, outside of fenders	49 feet 6 inches
Depth, molded	28 feet
Mean draft	23 feet 3 inches
Displacement on mean draft	8,230 tons
Gross registered tonnage	3,880 tons
Net registered tonnage	2,100 tons
Deadweight on mean draft	5,500 tons
Sea speed, loaded	10 knots
Indicated horsepower	1,500

The composite steamer was designed to provide a ship which could be economically constructed in spite of the scarcity of material. Because of this scarcity of material the vessel is a compromise between an all-wooden vessel and one built of steel—a compromise, in that the rapidity of construction and possible ease of obtaining the material, which are the points in favor of the all-wooden boat, would be combined with the greater possible size and increased strength afforded by the all-steel ship.

It is a well-known fact that the larger the ship the less the cost to construct and operate per ton of carrying capacity. The fact that there is a limit beyond which the size of the all-wooden ship cannot be carried practically is the principal handicap which this type has to meet. Therefore, for economy it is necessary to turn to a substitute approaching the all-steel ship. But the market conditions are not favorable at this time for obtaining steel plate in quantity, and therefore substitutions must be made for some of this material.

Employing Structural Shapes a New Departure

Owing to the unprecedented activity in shipbuilding the demand on the steel mills for the structural shapes peculiar to ship construction and for steel plate, which was formerly but a small proportion of the output of the mills, is greatly in excess of the amount which the mills could deliver within a practicable time. The structural steel shapes used in building construction, however, are more easy to obtain in the open market, as the mills produce far greater quantities of these shapes and a sufficient supply can be delivered from the supply on hand.

By exhaustive calculations and research it was found that these structural shapes could be used in ship construction, notwithstanding the fact that their strength per unit of section is somewhat less than ship steel and that difficulty would be encountered in working them to the elaborately curved surfaces of the average ship's hull. By using wood planking in place of the steel shell plating, a much lesser quantity of steel plate will be required, although the steel framing is designed to meet all requirements of strength.

Characteristics

To simplify the construction of the vessel to the greatest possible degree without impairing its utility, its efficiency of performance or its appearance is an important consideration, for not only would this effect a saving in money, but it would also affect the length of time necessary for building a fleet of such boats, which is perhaps the most important feature.

With this end in view, the ship was made rectangular in midship section, with this uniform body extending for 58 percent of its length, or 187 feet. The bottom has no dead rise, being flat from side to side, except for the turn of the bilge, which was made on a radius for simplicity. The sides are straight with no tumble home and the decks have no camber

Advantages

The features enumerated above make it possible to standardize the vessels and construct them in much the same manner as standard buildings are erected. The structural parts can be fabricated at the mill and shipped in that condition, it being only necessary to assemble them when they reach the shipyard. With the substitution of the I-beam floor for the usual "built-up" section, an enormous amount of riveting is eliminated. More than half the remaining amount of riveting can be done by power at the mill.

The design is arranged so that if at any time it is found that steel plates can be readily procured the wood planking can be removed and steel plates substituted, thus converting the vessel into a standard steel ship.

Life

The life of a composite ship with yellow pine planking is placed at from twelve to fifteen years. It is thought, however, by the designers that it would be desirable to remove

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the wood planking in about eight years, at which time corrosion between the steel and wood will probably begin to be noticeable. After the steel plating is substituted for the wood, the vessel will be good for as long as any other steel boat.

COST

A comparison of costs between the three types of ships shows the advantage to be with the composite vessel, when the time necessary to construct and the life of the vessel are taken into consideration. The cost of the wooden ship will be about $125 (£25.6) per ton deadweight capacity, which would for this sized ship (if it were possible to build a wooden ship as large as this) total $687,500 (£141,000). An ordinary steel ship of this size would cost, even with the government prices on steel, in the neighborhood of $150 (£30.8) per ton, which will total $825,000 (£169,000). The composite vessel will cost, if built in quantities sufficiently large to make the mill fabricating idea practicable, about $136 (£28) per ton, which will total about $750,000 (£153,500).

From this it will be seen that the composite vessel will cost only a small amount more than the wooden vessel, while it has a life probably twice as long, and will cost considerably less than the steel vessel and is just as serviceable.

TYPE GENERALLY APPROVED

The plans and specifications have been approved by Lloyd's Registry of Shipping, which gave the vessel a rating of "A-1" for twelve years; approved by the American Bureau of Shipping, which classed the ship "A-1" for fifteen years; approved by Theodore E. Ferris, for the United States Shipping Board. On the strength of this last approval, bids were submitted to Mr. Eads Johnson, New York representative of the U. S. Shipping Board.

GENERAL ARRANGEMENT

The vessel is of the two-deck type with forecastle, short poop and bridge house amidship. Three-inch guns are mounted fore and aft. The aft gun, being mounted on top of a small deck house which forms a companionway to the gunner's quarters, permits of better defense against submarine attacks, due to the greater possible depression of the gun which allows of action at closer range.

The forecastle provides space for hospital, wash-room, quarters for seamen, firemen and boatswain. The midship deck-house contains quarters for officers, petty officers, wireless operators, chief gunners, engineers, oilers, cooks, messmen, etc. The poop contains quarters for the gun crew, stores and ammunition.

The vessel has a semi-elliptical stern and straight stem. Two wood pole masts, each fitted with three 3-ton booms, serve the holds. Access is gained to the holds through four cargo hatches.

'Tween decks the vessel is divided by six watertight transverse steel bulkheads into four cargo holds, fore and aft peak tanks and machinery space. A non-watertight steel screen bulkhead is fitted between the engine and boiler rooms. Water ballast is carried in the fore and aft peak tanks. Two 50-ton capacity feed water tanks are fitted in the engine room immediately abaft the screen bulkhead. Culinary water is carried in two steel tanks, having a total capacity of 8,000 gallons, located in the bridge space.

FRAMING

Twenty-pound plate forms the stem and extends down below the turn of the forefoot, so shaped as to efficiently connect with the flat keel plate. Tie plates connect the stem with the two forward frames. The stem proper is of white oak, rabbitted to received the planking.

The stern frame is of forged or cast steel designed to provide ample landing surface for the planking.

A box type keel is fitted, the keel being built up of channels and plates with wood filling. The vertical keel consists of 20-pound intercostal plates clipped to the transverse floors with angles. At the ends the weight is reduced to seventeen pounds. A 36-inch by 40-pound tie plate laid fore and aft over the tops of the floors connects the vertical keel plates by double clips. This tie plate is reduced to 17 pounds at the ends; butts are single strap and treble riveted. Four 20-pound side keelsons are fitted intercostal.

Frames of channel section extend from the upper deck to the upper turn of the bilge. Angle frames are fitted to the bilge brackets and lapped on the side frames and to the floors at the ends. This type of framing extends between the fore and aft peak bulkheads. Framing fore and aft of these bulkheads is of angle section with reverse bars.

The floors consist of 30-inch by 120-pound structural I-beams, continuous from side to side. As the vessel fines away fore and aft 16-pound plates with 1½-inch by 3-inch by 11.9-pound double angles are used instead of the I-section. Lightening holes are cut so as to assure the greatest possible carrying capacity. Bilge brackets are of 20-pound plate, with a flange on the upper edge.

Lower and upper deck beams are of channel section, 12 inches by 25 pounds on alternate frames. Lower deck stringers are 48 inches by 20 pounds, plates running for one-half length reduced to 36 inches by 20 pounds at ends. Three-and-a-half inch by 8.5-pound stringer angles are fitted inside of the frames.

Fore and afters of 18-inch by 60-pound I-beam sections are fitted at the ends of the hatches and are supported by stanchions. Tie plates 24 inches by 20 pounds run fore and aft each side of hatches. These tie plates are connected to the stringer plates by diagonal ties 18 inches by 20 pounds running at an angle of 45 degrees in pairs.

The upper deck stringer plates are 60 inches by 20 pounds, double for half the length and reduced to 42 inches by 20 pounds single plate at ends. A 15-inch by 30-pound channel forms the stringer and watering angle. Forty-eight-inch by 20-pound tie plates run fore and aft each side of the hatches. A continuous 18-inch by 65-pound I-beam section runs fore and aft each side of the hatches and is supported by stanchions. The diagonal tie plates are 18 inches by 20 pounds.

To assist in strengthening the vessel against hogging and sagging diagonal tie plates 18 inches by ¾-inch run from the bilge strake to the upper sheer strake in pairs at an angle of about 45 degrees. The planking is notched in way of these tie plates.

At the turn of the bilge a 72-inch by 25-pound fore and aft strake is run lapping on to the floors and side frames. The sheer strake at the second deck is 42-inch by 25-pound for one-half the length and reduces to 20 pounds at the ends, 60-inch by 20-pound doubled for one-half the length, and reduced to 48-inch by 20-pound being used as an upper deck sheer strake at the ends. Bridge sheer strake, 45-inch by 15-pound doubled; poop, 36-inch by 14.7-pound; forecastle, 36-inch by 15½-pound.

The six watertight bulkheads are of 15-pound plating in the lower strake, reduced to 10 pounds between decks. A strong vertical web stiffener extends from the second keelson to the deck stringer on each side of the vessel built up of 20-pound plate 30 inches deep at the bottom, 18 inches at top with 5- by 5-inch by 16.2-pound face bars. Intermediate vertical stiffeners of 8-inch by 11.25-pound channel sections are placed on 24-inch centers on

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opposite sides of the bulkhead. Stiffeners in way of keelsons are bracketed to same. Fifteen-inch by 33-pound channels are run as horizontal stiffeners between the vertical webs and between the web and sides of the ship. Brackets tie these stiffeners to the frames.

The screen bulkhead which separates the engine room from the boiler room is made up of 10-pound plate. Coal bunkers are provided outboard of the engine and boilers. They are built of 3-inch yellow pine planking sheathed with No. 16 U. S. S. G. steel forming fore and aft bulkheads. This planking is supported by 16-inch by 15-pound channels on 24-inch centers. Coal is also carried in the bridge space when necessary and auxiliary coal capacity can be arranged for in the cargo hold.

Hold stanchions are 8-inch by 32½-pound "H" sections. 'Tween deck stanchions which land immediately over hold stanchions are of the same section and weight.

Decking and Planking

The second deck, forecastle, poop and bridge decks are planked with 3-inch yellow pine, 4-inch yellow pine decking being used on the upper deck. Planking throughout is yellow pine worked in lengths not shorter than 20 feet. Bottom and bilge planking is 8 inches thick, thickening out to 15 inches at the garboard strake. Seven-inch planking is used between the upper turn of the bilge and the second deck. Between the second and upper deck the planking reduces to 6 inches and to 4 inches in way of bridge, poop and forecastle. Bilge keels terminate at frames 12 and 55.

Fastenings

All fastenings, other than rivets, are composition brass or galvanized iron, bolt fastenings through wood being driven with a drift from 1/16 to ⅛ inch, according to nature of wood and length of bolt. Bolts exposed to weather are plugged. Grommets are fitted to all such connections as are necessary. Tree nails are of locust.

Rudder

The rudder is of the single plate type with arms keyed to the main piece, the stock and main piece being of wrought steel.

Propelling Machinery

The vessel is propelled by a vertical inverted triple expansion engine, developing 1,500 indicated horsepower, with cylinders 21½ inches by 36 inches by 63 inches diameter by 42 inches stroke. The engine turns a single four-blade, right hand sectional adjustable propeller.

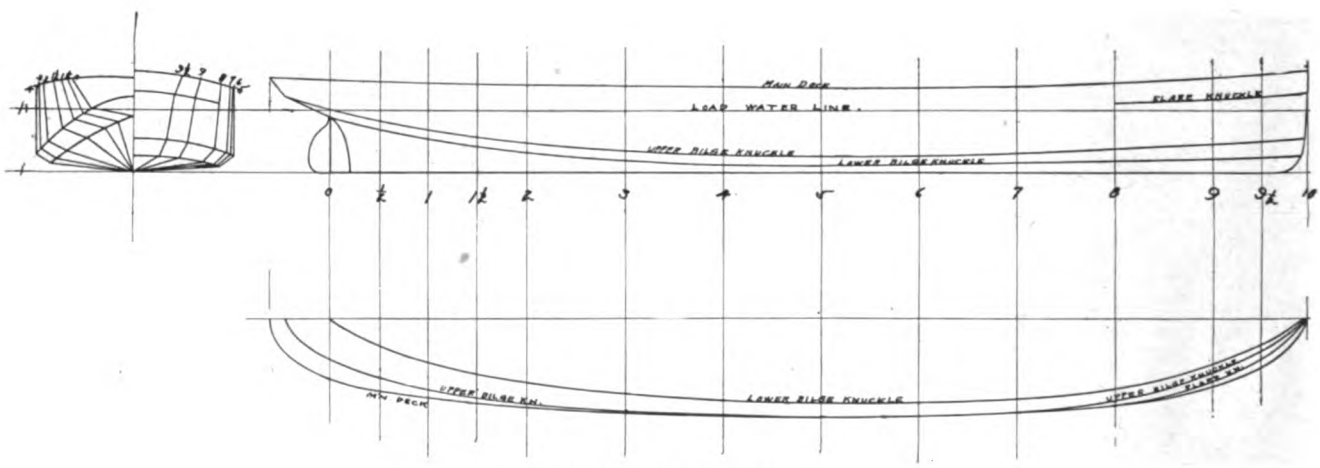
Steam is furnished by Scotch boilers at 190 pounds working pressure. The main and auxiliary condensers have a condensing surface of 2,400 and 1,000 square feet respectively. The usual auxiliaries and pumps are provided.

New Design of Freight Steamer

BY R. D. KARR

IN the present times of frantic, or rather intensive, construction of ocean-going bottoms of all kinds, the closest attention is being given to efficient expenditure of labor, time and material. Implements for handling material are of elaborate proportions and large capacity, routing of work is carefully thought out, machines of improved designs find an eager market in the many shipyards old and new, and the fabrication of steel and wood is carried out to the last possible step before assembly in the ship.

But are all these items most advantageously utilized? In the last analysis the speedy and economical construction of a suitable carrier of freight and merchandise on the high seas is the ultimate aim and sole purpose of all these hair-splitting efficiency methods. Now, beginning with this object in view and keeping it always before us, let us strike at the root and source of all evil—the original design and conception of a new cargo ship of reasonable size and ordinary requirements.


MAIN DECK
LOAD WATER LINE
FLARE KNUCKLE
UPPER BILGE KNUCKLE
LOWER BILGE KNUCKLE
0 ½ 1 1½ 2 3 4 5 6 7 8 9 9½ 10
UPPER BILGE KN.
LOWER BILGE KNUCKLE

Lines of Simplified Freight Steamer

In Taylor's "Resistance and Propulsion of Ships" and from various other authorities on ships' form and resistance, we learn that the performance of a ship is not affected by the shape of the vessel's sections, but by the shape of the curve of areas and the relation of length to beam and draft. Also, that generally the most advantageous sections are U-shaped forward and hollow V-shaped aft with a fine entrance for the forward waterlines and an easy run aft to the propellers. For this reason the writer suggests that the form of the hull be made up of warped surfaces with straight line elements and curvilinear directices, the straight line elements to be in line with the square frames of the ship.

With this construction no bending slab would be needed for the frames. All the shell plates could be rolled in straight rollers to the correct shape, as there would be only a single curvature. There would be no more girthing of frames in the mold loft for the spotting of rivet holes, and there would be only three or four lines in the whole ship to fair. In calculating displacements it will be seen

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that the sections will be simple trapezoidal shapes and easy to estimate.

It is the opinion of the writer that after towing a series of tank models, type curves could be obtained for varying speed length ratios, $\frac{V}{\sqrt{L}}$, to go with the correct load water-line that would obtain the required curve of areas on a given displacement. These data curves for the upper and lower bilge knuckles (see sketch) would give a definite ship form within an hour after "steam is up on the intergrator and the grease cups screwed down on the slide rule."

The outstanding feature of the new design is the bilge strake. This is of equal width or nearly so all fore and aft. It starts at the stem and running aft the upper edge widens out in the half breadth and at the same time dropping in the elevation in an easy curve. It thus forms the lower corner of the U-shaped sections, and running along amidships it corresponds to the bilge strake in present vessels. Following aft both edges rise in elevation in a gentle curve, and the lower edge runs inboard to meet the centerline of the ship at the stern frame. Meanwhile the upper and outer edge runs in around the stern under the main deck and corresponds to the legitimate knuckle in the present ships. There will, of course, be a knuckle line running aft from the stern frame on the centerline of the ship under the counter, but by the time it reaches the knuckle under the main deck the port and starboard bilge strakes will flatten out square across.

Examining the interior of this new boat, first of all the frames are straight. It will be necessary to cut some of them at the bilge strake and make the connections of the various lengths with large brackets. But, as can be seen from the body plan, most of the frames up forward and some of those aft can be bent at the knuckles without difficulty. The two knuckle lines at the bilge have strong fore and aft continuous longitudinals to provide connection to the adjacent shell plates. There will be no shell plating with a knuckle in it, but the plate edges will run along the knuckles on either side.

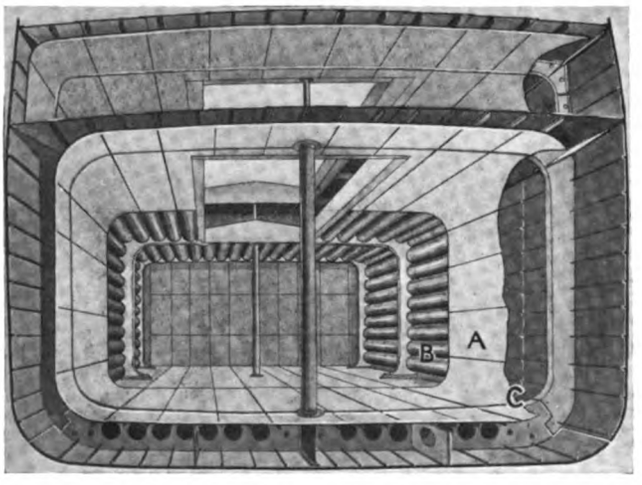
The longitudinals at the knuckles could be made deep and of special construction, affording considerable longitudinal strength, for it will be seen that the very run of the knuckles fore and aft gives an arched construction, and along with the continuous bilge strake plating the break in the continuity of the hull will be a source of strength rather than weakness, as is the case with the chine piece in V-bottom motor boats. The tank margin could land very neatly on the flat bilge strake, or, better, one of the longitudinals at the knuckles could form the margin plate. The flare-up forward could be obtained by running a knuckle line from the stem aft as far as necessary, and the frame could be bent here without difficulty.

From the foregoing it can easily be seen that the fabrication will be much simplified and speeded up. The whole construction will get a boat to the shipowner quicker than the present designs permit. At times like these, when the capacity of a yard is increased, everybody wins and nobody loses, for there is a crying need for all the tonnage that can possibly be built for several years to come. It is believed that the construction outlined above has several commendable and patentable features and steps are under consideration for the protection of all rights of the originator of the design.

Non-Sinkable Ship Proposed

Myron F. Hill, patent attorney, of New York, who recently made public a proposal to build ships of cast steel sections welded together by an arc-welding process, now proposes a new type of construction which may be applied to any type of steel ship, which, it is claimed, will render the ship practically unsinkable and thus effectively meet the submarine campaign against shipping.

The construction consists in having the sides, decks and bulkheads of the vessel lined with watertight air cells formed by welding thin sheet steel plates either to the inner edges of transverse frames, as shown at *A* in the illustration, or across the edges of longitudinals, as shown at *B*. The cells may be flat or arched and both systems may be combined—that is, large transverse chambers may



Section of Cast Steel Ship, Showing Thin Steel Plates Welded to Transverse and Longitudinal Framing, Deck Beams and Bulkhead Stiffeners, Forming Buoyant Cellular Structure to Prevent Sinking of Ship by Torpedo or Mine Attack.

be used for the machinery space and longitudinal chambers for the cargo holds.

Air cells formed of steel having welded joints, it is claimed, are safe from leakage, because to crack a welded joint a sharp bend of the material is necessary, which can occur only along the edge of a breech in the hull. While this air cellular construction can be applied most effectively to the cast steel ship construction proposed by Mr. Hill, nevertheless the system may be applied to ships of ordinary type, provided the riveted joints be welded sufficiently so that they will not be loosened by an explosion. If sufficient buoyancy is not provided by the cellular structure, watertight air containers, as described by Mr. William T. Donnelly in the June issue of MARINE ENGINEERING, could be included in the cargo.

The weight of the thin steel cellular construction, it is claimed, is not prohibitive, and its extra cost would be offset by reduced insurance premiums. It is also suggested that the cellular structure be connected to a supply of compressed air for driving out water in case any part of the structure is damaged by a torpedo or other means.

Largest Drydock in Argentina Completed

According to press dispatches from Buenos Aires, the largest drydock in Argentina, located at Puerto Militar, near Bahia Blanca, has been completed and successfully tested under the supervision of a board of officers of the Argentine Navy. Actual construction of the dock was begun in the latter part of 1911. Official tests showed that the pumping plant is capable of freeing the dock of water in seventy-five minutes.

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STRAIGHT-LINED SHIP MODEL EXPERIMENTS

Ship-Shaped Models Developed from Experiments with Straight-Lined Forms

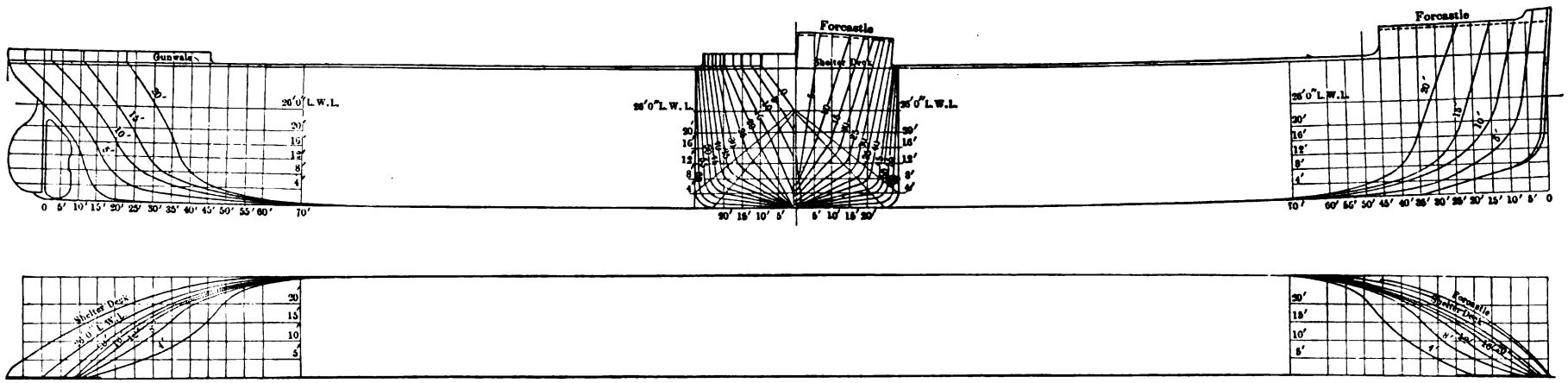

Fig. 1.—Proposed Emergency Single-Screw Steamer Type D. 410 Feet Between Perpendiculars by 55 Feet Beam by 37 Feet 6 Inches Depth Molded. Length of Fore Body, 70 Feet (17.07 Percent). Length of Middle Body, 270 Feet (65.86 Percent). Length of After Body, 70 Feet (17.07 Percent). Displacement on 26-Foot Load Waterline, 14,130 Tons. Block Coefficient, .844. Wetted Surface, 38,500 Square Feet

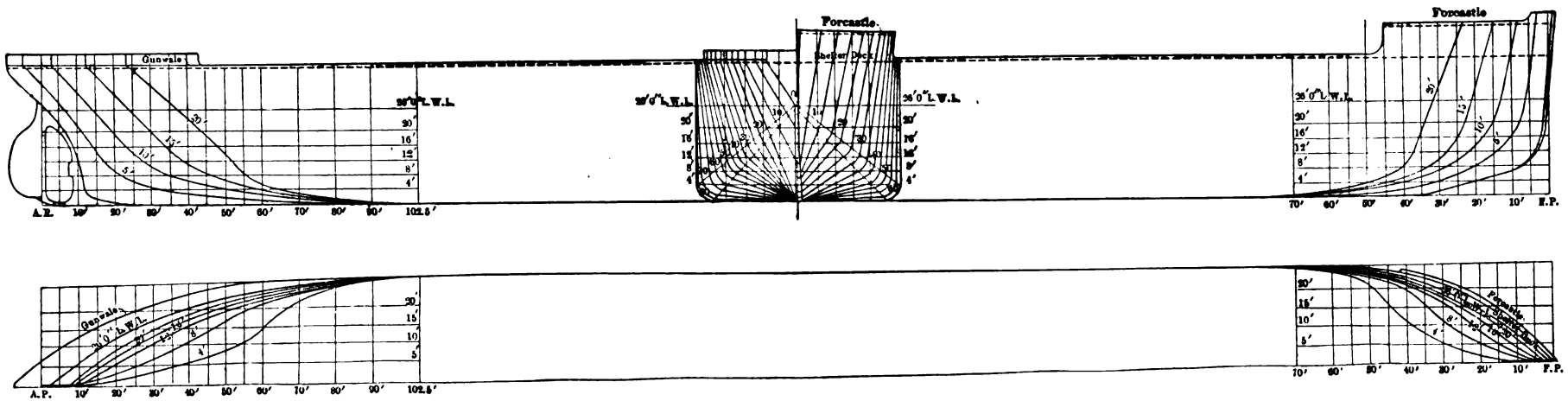

Fig. 2.—Proposed Emergency Single-Screw Steamer Type E. 410 Feet Between Perpendiculars by 55 Feet Beam by 37 Feet 6 Inches Depth. Length of Fore Body, 70 Feet (17.07 Percent). Length of Middle Body, 237 Feet 6 Inches (57.93 Percent). Length of After Body, 102 Feet 6 Inches (25 Percent). Displacement on 26-Foot Load Waterline, 13,740 Tons. Block Coefficient, .82. Wetted Surface, 37,840 Square Feet

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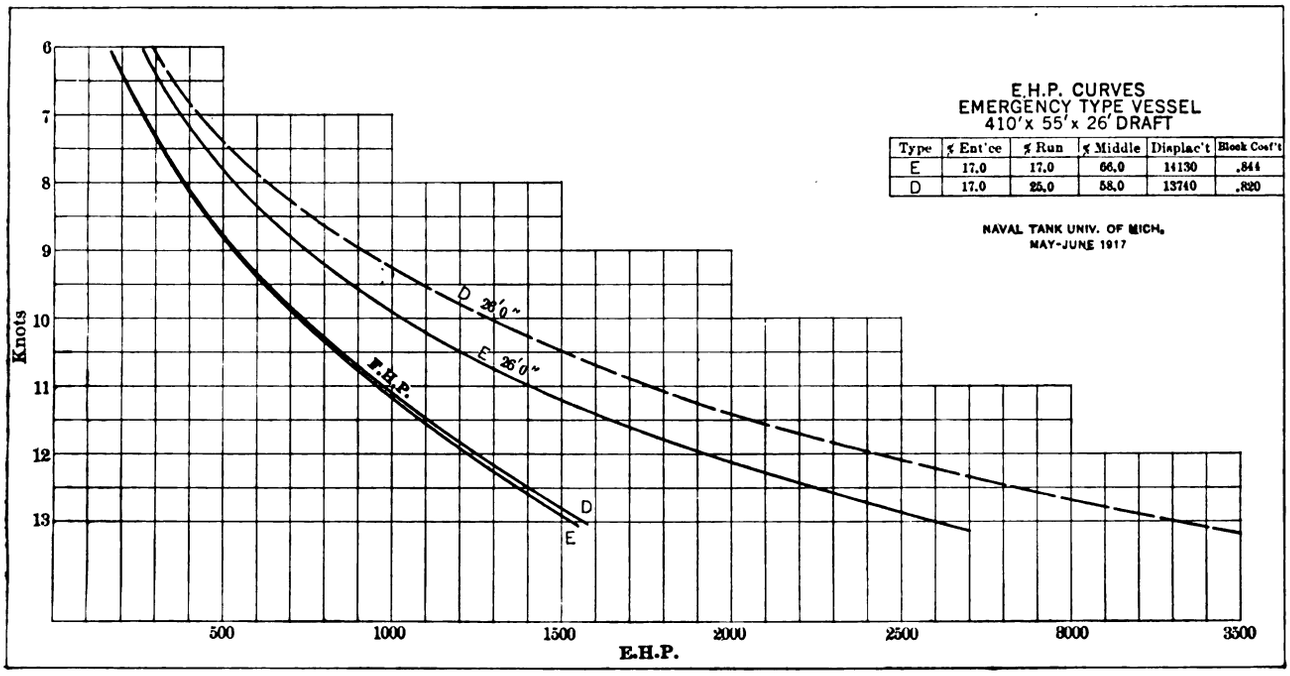

Fig. 3.—E. H. P. Curves of Types D and E Steamers

Straight-Lined Ship Model Experiments

Investigation of Form of Seagoing Vessel Best Suited for Emergency Construction—Straight Line Hull Modified

BY ALBERT ED. SAUNDERS *

IN an endeavor to meet the present emergency caused by war shortage of tonnage, shipbuilders generally have been devoting their energies towards developing a vessel which would have necessary seagoing qualities, be economical to drive and at the same time be of the simplest possible form of construction; such form to follow straight lines to the limit of practicability in order that, if necessary, structural shops could fabricate the greater portion of the vessel's structure, leaving to the shipyard the erecting and the fabrication of the more complicated parts of the structure.

At the instance of Mr. J. Howard Pew, president, Sun Shipbuilding Company, Chester, Pa., the writer made designs embodying these ideas, and models were towed by Prof. H. C. Sadler at the University of Michigan experimental tank, for the purpose of obtaining the desired information as to the form of vessel best suited to the purpose in view.

The results of our investigations in the form of the vessel's lines, together with the speed and power data obtained, were presented to the Shipping Board early in June, for the benefit and guidance of those of the shipbuilding world interested, and particulars have also since been given to such yards as have approached the Sun Shipbuilding Company's officials on the subject, with the result, we hope, that the country is benefiting by the research undertaken.

A review of the work done will no doubt interest and benefit those shipbuilders who may wish to work along these lines, and who may not have already been informed on the subject.

For the purpose of obtaining the fullest information possible, a start was made by towing a model having straight lines in every direction. The bilge was rectangular, sides vertical and parallel for a greater part of the length, terminating in a V-shaped entrance and run; the keel at the stern cut up to considerable rake, and at stem only slightly (type "A"). This was followed by rounding the bilge to a radius and slightly rounding the shoulders (type "B"). The next step was to round the shoulders to a large radius and also to ease the knuckle where the keel left the base line to rake up aft (type "C"). As will be observed, the resistances of these forms of model were abnormal and not within the range of practical application. The first idea was to fit twin overhung rudders and a central strut for the propeller. From the observations made during these experiments, it was evident that a more shipshape form, with stern frame and a single rudder, was the more practical method of meeting this feature.

By coincidence, Prof. H. C. Sadler was also investigating along the straight line idea, and from the experience gained with the experiments already outlined, and the form suggested by Professor Sadler's ideas, new lines were designed, approaching more nearly ship form, but still retaining the straight line idea (type "D" and type "E").

The accompanying diagrams explain themselves as to form, and the speed and power curves resulting from the change in model were most encouraging, and indicated that as an emergency vessel such forms could be adopted to advantage. A comparison of these curves with those

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STRAIGHT-LINED SHIP MODEL EXPERIMENTS

Data from Tank Experiments by Professor H. C. Sadler, at the University of Michigan

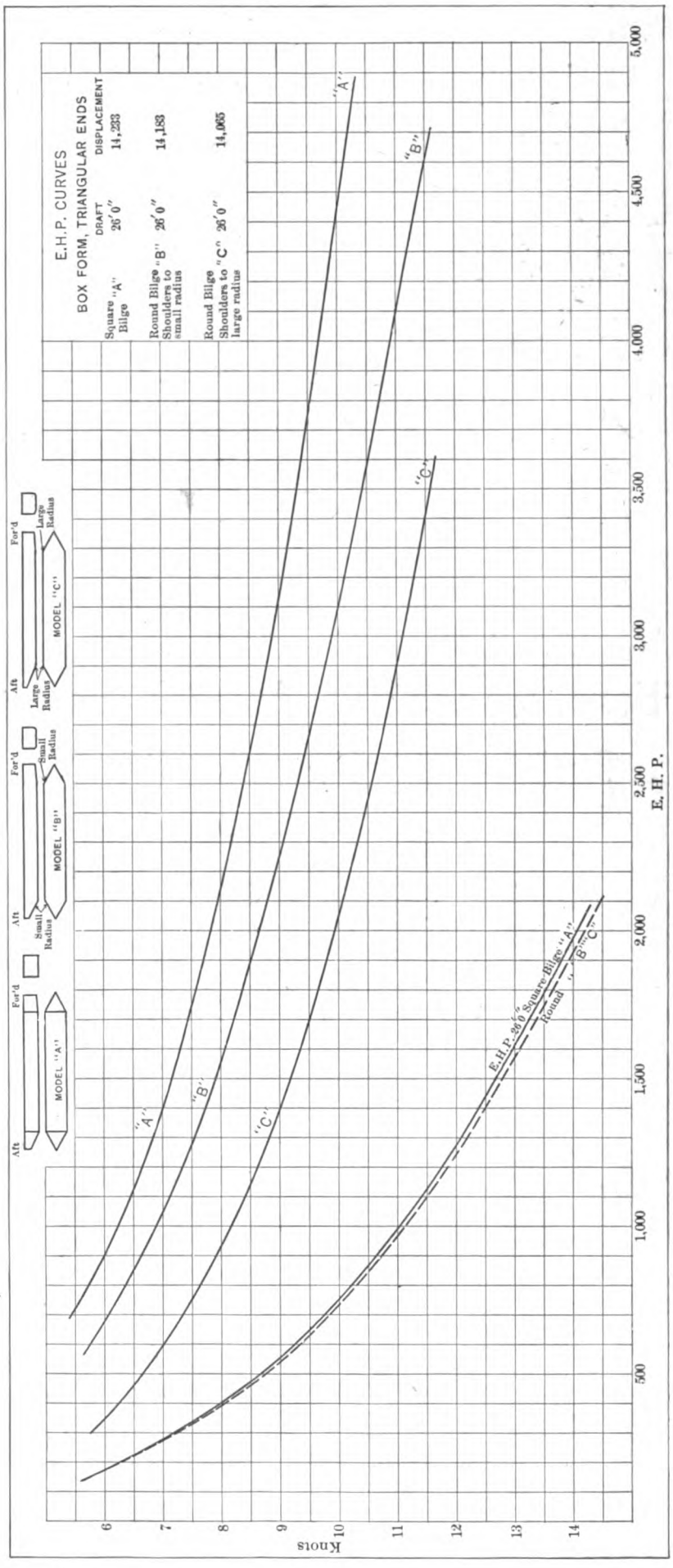

Fig. 4.—E. H. P. Curves of Box Form Models with Triangular Ends

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for vessels of usual form and similar dimensions, and even somewhat finer block coefficients, will show up remarkably in favor of this form.

There will, of course, have to be considerably more strengthening in these vessels for pounding and panting than in the normal-shaped vessel presenting curved surfaces. It will be noticed that the length of the middle body may be considerably in excess of the generally accepted practice for similar block coefficients, all of which will materially assist in the simplification of structure and consequent speed of manufacture.

The writer feels greatly indebted to Prof. H. C. Sadler for his services in conducting the experiments, and also for the valuable advice given in general during the development of the various designs.

Professor Sadler has promised to treat this subject in a paper to be read before the Society of Naval Architects and Marine Engineers at its next meeting, when the whole series of experiments will meet with his analysis, and no doubt prove to be of value to the technical shipbuilding world. In the meantime, this matter is now given to assist, at the time when most needed, any shipbuilder who may be working along these lines.

The plates are lettered in the sequence in which the experiments were conducted, and will explain themselves without further comment at this time.

Width of Quay Terminals and Proportional Dimensions of Piers, Slips and Sheds for Inland Barges and Ocean Freighters

BY H. MC L. HARDING *

Quays are mostly confined to inland rivers or where there is available a long waterfront.

A pier may be considered as two quays placed back to back.

As to the following principles, there must be exceptions, as in cases where there is not sufficient land available, or the appropriations are not sufficient.

QUAYS

To attain the best results, the desired width or depth of the property for a quay terminal can be accepted as about 400 feet. For this width the space may be divided as follows:

	Feet
Frontage or the area between the face of the quay wall and the front of the shed	45
Steel shed width	60
Between shed and warehouse	60
Concrete warehouse width	80
Space rear of warehouse	55
Track space for car storage	100
	400

Where less width is available, as 250 feet, it may be advantageously divided as follows:

	Feet
Frontage	35
Shed	50
Between shed and warehouse	50
Warehouse	70
To the rear of warehouse	45
	250

Provision may be made for storage tracks at the end or ends of the terminals, or on some rear areas. Where there is even less area, the width of the shed may be reduced to 40 feet, and additional shed capacity can be economically obtained vertically and not horizontally. When there is less than 200 feet, the warehouse can be placed elsewhere, as to the rear of the open or coarse freight storage area. In this case the division can be:

	Feet
Frontage	35
Open storage area	40
Car tracks	35
Warehouse	70
	180

The above will serve to indicate, in laying out quay terminals, the area necessary for successful operation. Land to the rear of a public road, or of lines of railways, can be utilized advantageously for warehouses by installing carrier connections.

PIERS

At basins of inland waterways it is often advisable to install piers on account of the water frontage being limited or for concentrating the terminal works.

If the pier be 350 feet in length to accommodate a barge 300 feet long, 40 feet wide, the width of the pier should be 125 feet; the slip, 180 feet wide; the shed, 300 feet long, 60 feet wide, and 30 feet clear height beneath the roof trusses. Provision is here made for four barges abreast.

If the pier be 675 feet in length to accommodate two barges, in tandem, on each side of the slip, and four abreast with a bargeway between for the barges, the width of the pier should be 150 feet, the slip 225 feet wide, sheds 300 feet long, there being two sheds in tandem, each 80 feet wide, 30 feet clear height below the girders.

For a pier 1,000 feet long the width of the pier should be 170 feet, the sheds (three) each 300 feet long, 80 feet wide, 30 feet high below the girders, and machinery for tiering and for transverse and longitudinal movements.

CONCLUSIONS

Pier, 350 feet long, 125 feet wide; slip, 180 feet wide; shed, 300 feet by 60 feet by 30 feet.

Pier, 675 feet long, 150 feet wide; slip, 225 feet wide; shed (two), 300 feet by 80 feet by 30 feet.

Pier, 1,000 feet long, 170 feet wide; slip, 225 feet wide; shed (three), 300 feet by 80 feet by 30 feet.

For ocean freighters at marine terminals the dimensions should be:

Pier, 600 feet long by 150 feet wide; slip, 250 feet wide; shed, 500 feet by 80 feet by 30 feet.

Pier, 1,200 feet long, 170 feet wide; slip, 350 feet wide; shed (two), 500 feet by 80 feet by 30 feet.

By making a shed 30 feet high its usual capacity can be trebled. This means that such a shed utilizing high tiering with 80 feet in width, is equal to a shed 240 feet wide, tiering 5 feet high.

The cost of mechanical handling, including tiering, 15 to 20 feet high, with the interest on the investment, maintenance and amortization, is less than the handling by manual labor, tiering 5 feet in height.

* Engineering Terminal Expert, New York State Barge Canal, New York.

New Ocean Terminals to be Built for Emergency Fleet

The Council of National Defense has created an advisory commission on terminal facilities to work with the General Munitions Board and with the special committee of the Board on Storage Facilities. Francis Lee Stewart, consulting engineer, formerly chief engineer of the Baltimore & Ohio Railroad, who represents the ports of Baltimore, will be chairman of the commission.

The committee is making a study of the ocean terminals of the country for the use of war supply vessels, and it is understood that new terminals are to be built especially for the assembling and loading of supplies for American ships abroad and for the Allies.

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SALVAGING THE SESOSTRIS

Reclamation of Once Famous Kosmos Liner

Fig. 1.—*Sesostris* on beach at Ocos, Guatemala, Showing Relative Distance from High Water

Fig. 2.—*Sesostris*, as She Floated in the Lagoon Prior to Final Salvage Operations

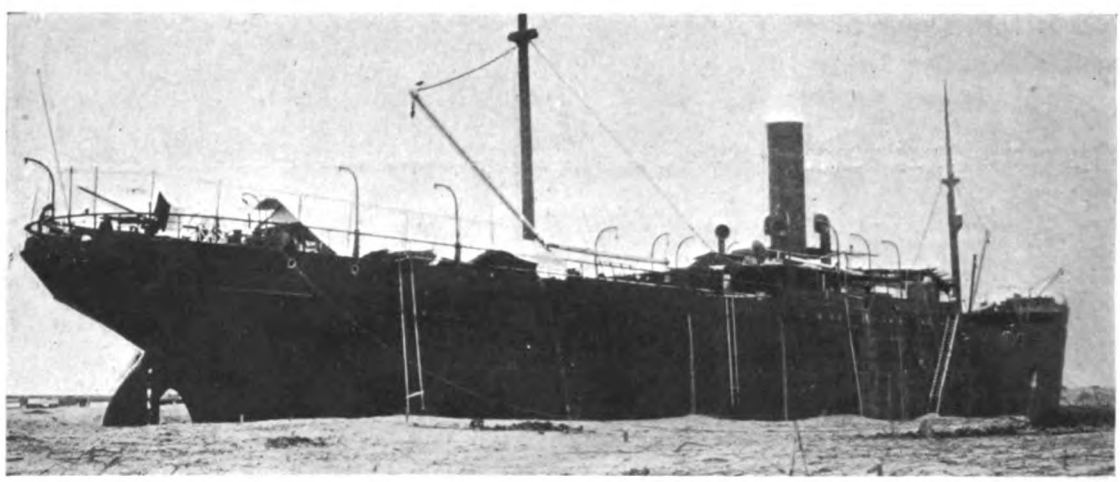

Fig. 3.—Side View of *Sesostris* Afloat in Lagoon. Water Not Visible in This Picture

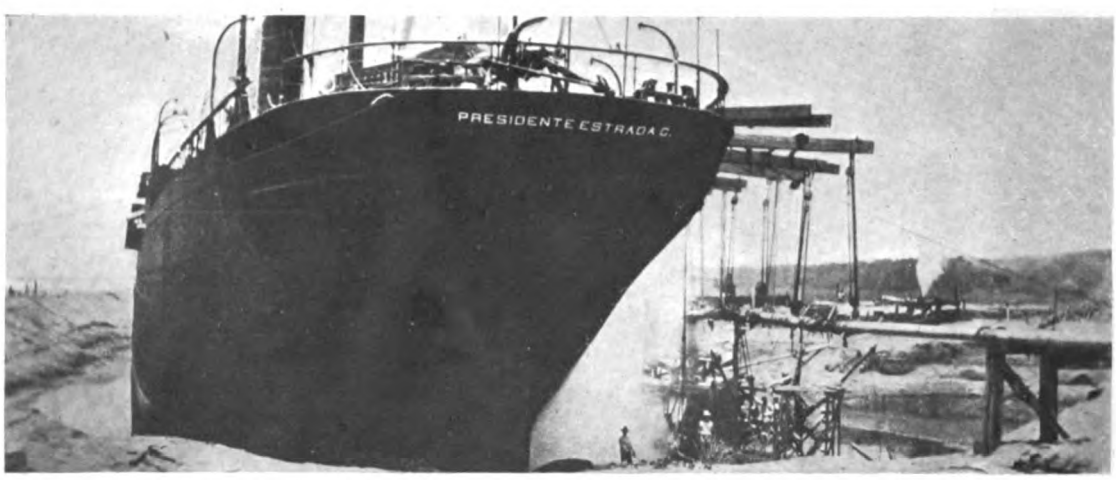

Fig. 4.—*Sesostris* (*Presidente Estrada C.*) Just After the Final Salvage Dredging Operations Were Started

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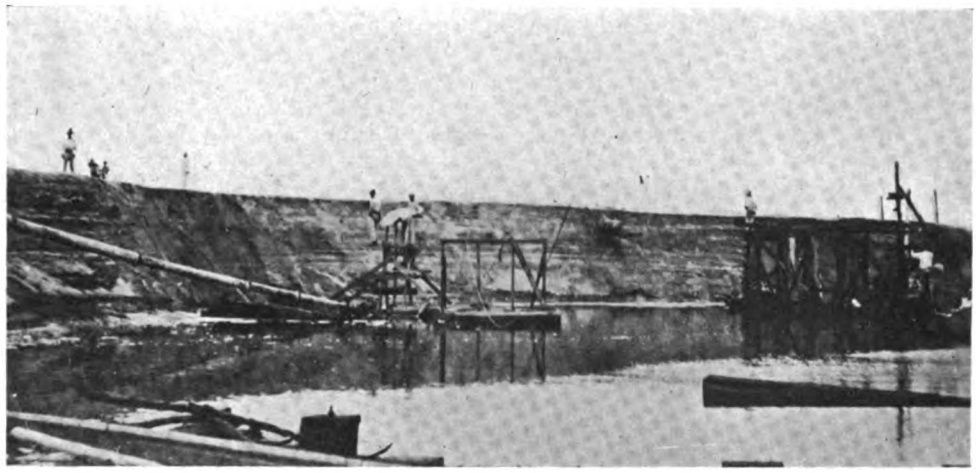

Fig. 5.—Portion of the Lagoon Giving an Idea of the Vast Amount of Sand Removed

Salvaging the Sesostris

Once Famous Kosmos Liner Reclaimed for Active Service After Ten Years at Rest on the Beach at Ocos, Guatemala

BY GILBERT C. DOHM *

POSSIBLY one of the most remarkable salvage operations ever undertaken on the Pacific Coast was brought to a successful termination by the Skinner Syndicate of Seattle, Wash., when on March 24, 1917, the former Kosmos liner *Sesostris* was again floated from her landlocked position in the sand of the beach at Ocos, on the west coast of Guatemala, where she had remained undisturbed for almost ten years.

Drifted Ashore on a Calm Night

On the night of September 15, 1907, while lying at anchor in the open roadstead of Ocos, Guatemala, and awaiting to take on a load of coffee, the ship suddenly became unshackled from her moorings and, swinging around broadside to the beach, gradually drifted ashore unbeknown to anyone on board. The high tide which was running at the time helped place her well up on the beach, but, contrary to general opinion, there was no storm or strong wind at the time; the water was smooth and a bright moon and ideal conditions prevailed and the unfortunate occurrence can be attributed to nothing but neglect on the part of the officers and crew, all of whom were apparently asleep.

Word was immediately sent to other ships of the Kosmos line plying in nearby waters, two responding to the call for assistance, but their efforts to float the *Sesostris* were futile.

Acted as a Breakwater

Acting as a sort of breakwater as she lay there, the shifting sands kept in motion by the surf and strong currents prevalent along that beach gathered about her and she was held fast. As time passed more and more sand gathered about, changing the actual contour of the beach for a considerable length and thereby placing her further and further inland, not by any actual movement of the ship itself, but by the formation of new beach about her. Before the final salvage operations were started she was about 200 feet up on shore from the high water mark.

For years the *Sesostris* was used as a landmark to guide mariners, and in many instances fixed their point of destination to take on a load of coffee from coffee houses at Ocos.

Abandoned by the Underwriters

After unsuccessful attempts were made to refloat her, the underwriters decided not to make any further attempts and she was sold on November 18, 1908, being purchased by a Spaniard named Bruno G. Mijares, of Tapachula, Mexico, from Oetlinger Gebrüder, of Hamburg, Germany, for $20,000 (£4,100).

Knowing the peculiarities of the beach at this point, it is believed that Mijares had hopes of the beach again changing and a high tide lifting her from her position. It is Mijares' claim that this actually happened once, but neglect on the part of the caretaker who was stationed on the ship to take up on the cables, which were fastened to anchors laid out a considerable distance in the sea to prevent her from going inland any further by her own movement, left her in practically the some position when the tide receded.

Previous stories about her being used as a hotel and lighting up the city of Ocos by electricity obtained from her own generators, are without foundation. It is, however, true that the ship was cared for and kept in an almost perfect state of preservation. When floated the machinery was well oiled and polished and the propulsive units and auxiliaries were in almost perfect condition, with the exception of the boilers, which required retubing.

Attempts Made to Refloat Her

Between the time that the *Sesostris* drifted ashore and the final successful salvage undertaking, a number of other attempts were made to refloat her which, for one reason or another, simmered into failures. The first of

* Associate Member, Society of Naval Architects and Marine Engineers.

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these attempts was made in 1912-13 in the name of the Philadelphia Breakwater Company, but it is alleged that it was not actually a Philadelphia Breakwater Company's undertaking. After this attempt had failed the ship reverted to her former owner, and the enterprising Mijares rigged up the pumps which were left and started operations of his own by dredging the sand which had formed about her, and actually causing a lagoon to be made by the water which seeped through the sand from the sea, and in which a slight movement of the ship was perceptible. But he, too, gave up the task owing to his interests

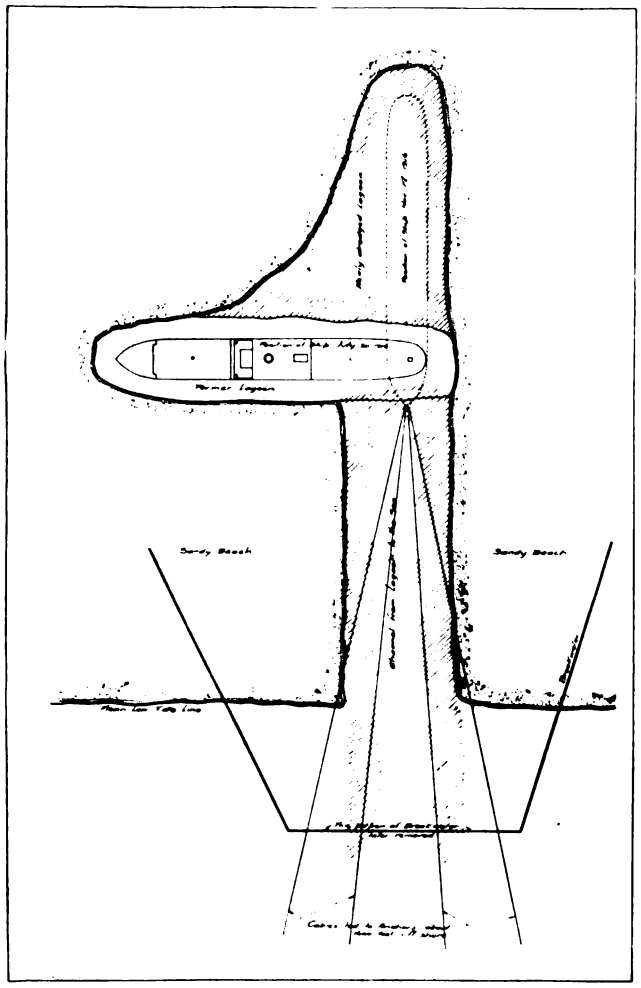

Fig. 6.—Plan Showing Position of *Sesostris* Before Salvage Operations Were Started and Position to Which Ship Was Pulled Before Being Drawn Seaward. Portion Within Shaded Area Was Dredged Under New Operations.

in Mexico requiring all of his attention with the advent of the revolution.

Option on the ship was held for a short time by the Luckenback Steamship Company, of New York City, which after its expiration was obtained by Mr. Joseph Thebaud, who, early in 1916, interested Mr. D. E. Skinner, president of the Skinner & Eddy Shipbuilding Corporation, Seattle. Mr. Skinner, in turn, took the matter up with a number of his friends. After a thorough investigation was made, due to the present great demand for ships and the consequent high cost of tonnage, the Skinner Syndicate was formed. In conjunction with Mr. Thebaud, preparations were at once made towards salvaging this once famous ship. Surveyors were sent to inspect the condition of the hull, machinery and fittings, and a metallurgical test was made at Guatemala City on portions of the steel. So favorable were their reports that arrangements were at once made with the British Columbia Company to undertake the salvage work.

On July 30, 1916, the salvaging crew was landed from the salvage tug *Pilot* at Ocos, and on August 16 dredging operations were started on the lagoon, or artificial lake in which the ship was first floated, for the purpose of extending it in a way to permit the ship being turned and headed straight into the sea. Previous operations made by the other company in its attempts and by the owner himself had caused a partial lagoon to be made. The new operations necessitated the dredging of a considerable amount of sand, approximately 100,000 cubic yards, on the starboard side of the stern end of the ship and at the southerly end of the already present lagoon. It was also necessary to dredge out portions of the already present lagoon in order to deepen it and give better flotation to the ship. Fig. 6 shows the position of the ship on July 30 and the lagoon in which she lay, the part within the hatched area being that portion which was afterwards dredged under the new operations.

Final Salvaging Operations

There were three centrifugal pumps used when the dredging operations were first started. One 8-inch pump was placed on the sand alongside the lagoon and two 10-inch pumps were placed on a barge which was floated in the lagoon alongside the ship. The discharge piping was led to the land on trestle work, which in turn was erected on barges and floated in the lagoon. With each new movement of the ship the discharge lines were broken and replaced to suit the new condition. Steam was furnished entirely by the ship's main boilers, there being no donkey, and most of the fuel used was wood obtained from nearby forests.

The task of dredging the lagoon was completed on November 12 and the ship was brought around head-on toward the sea (Fig. 6). Work was then started on dredging a channel from lagoon to the sea, and on November 26 the first of a series of setbacks was experienced when the ridge of sand which protected the lagoon from the sea, and which had become narrow, weak and undermined, due to the dredging operations, was washed in by the heavy surf and strong currents running, threatening to fill the lagoon and channel with every high tide.

Construction of Breakwater Necessary

A rough barrier was immediately constructed which proved unsuitable, and it was decided to build a breakwater completely enclosing the bow of the ship, which afterwards proved indispensable. This was done by driving logs and sinking steel sheet piling into the sand for a depth of about 15 feet by means of a water jet (Fig. 8) and carrying this construction out into the sea as far as it was possible to work at low tide. The sheet piling was left there on the beach from previous operations, and, together with the timber, formed a fair protection, the whole being braced and shored up in the rear. Provision was made to remove that portion in front of the bow to permit the ship to pass through when operations had advanced that far.

Many Other Difficulties Encountered

Aside from the difficulties experienced in the actual salvage operations, many other obstacles arose which materially handicapped the progress.

There was no landing place along that sandy beach for many miles, and therefore all the apparatus, tools, food, etc., had to be transferred to small, open boats and brought to shore in that manner. This method had its disadvantages when the heavy surf and strong currents were running and had to be postponed at times, often

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SALVAGING THE SESOSTRIS

Reclamation of Once Famous Kosmos Liner

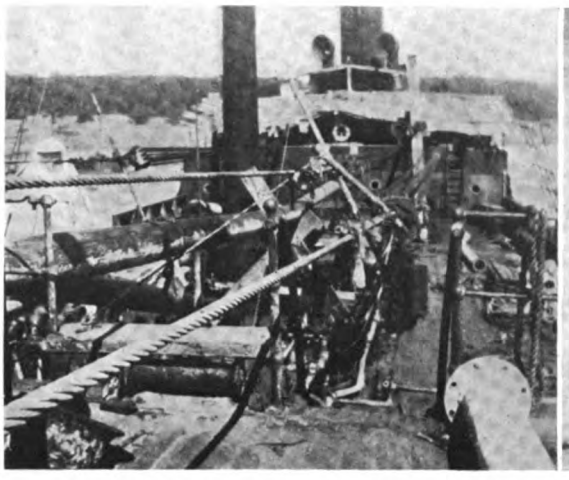

Fig. 7.—Deck View While Salvage Operations Were in Process. Tautness of Wire Cables Shows Strain Exerted.

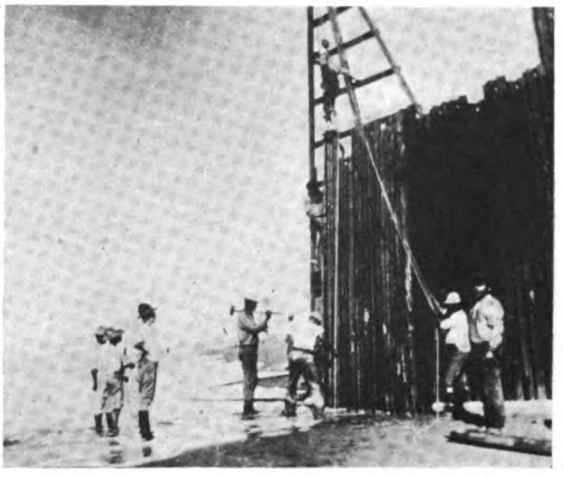

Fig. 8.—Building a Portion of the Breakwater

Fig. 9.—Showing Ridge of Sand Which Protected Lagoon From the Sea and Which Was Afterward Washed Away by the Surf.

Fig. 10.—Vessel Being Pulled Out of Hole in Breakwater

Fig. 11.—The *Sesostris Entering the Breakers*

Fig. 12.—*Sesostris* Awaiting a High Tide for Further Progress

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causing many days' delay, for the loss of any portion of the outfit, all of which was brought from the United States, by the overturning of a boat did not warrant the risk of transporting in heavy weather.

During the day the heat was intense and at night the conditions were not much better, the sand radiating at night what the sun had given up during the day. The crew was therefore housed in improvised shelters on the deck of the *Sesostris*.

Fuel was also scarce, and only wood was available at times. This was obtained from drift which came ashore and from nearby forests, where it was contracted for with the natives, who were often sceptical of the representatives' good intentions and had to be handled carefully. The hauling from the forests was done on cars run on temporary tracks which led up to the vessel.

Money with which to pay the crew was also hard to get, as there was none at all in Ocos, and therefore it was necessary for the paymaster to go to Guatemala City and get it there, the trip from here to Ocos and thence across the sandy wastes to the ship being made under heavy guard.

The commissary department, too, had its disadvantages, the galley on the ship serving as the kitchen. The drinking water was obtained and used only after passing through a series of filters.

However, these disadvantages were all well borne, and by sheer grit and perseverance on the part of all concerned the task was afterwards brought to a successful conclusion.

Tidal Data

As the plans for getting the ship off the sands were arranged according to the data obtained from the United States Coast and Geodetic Survey Tide Tables, a tide gage was constructed and placed in the lagoon. The tides were noted and a comparison with the values given in the tables was made, the two values in many instances varying as much as 40 percent. The gage itself finally became useless, due to the gathering of sand around it, making it impossible to read the figures, and the tide levels were then checked from the draft marks on the ship. The fact that real high tides only occurred three days in each month necessitated a well-planned program beforehand, so that advantage could be taken of every moment available.

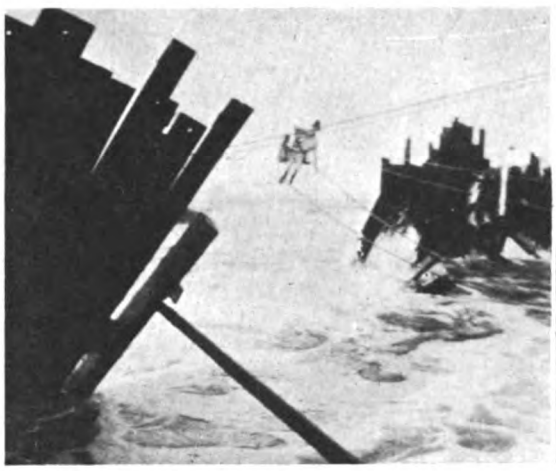

Fig. 13—Wreck of the Breakwater After Earthquake Shocks and Surf Had Demolished It

Fig. 14—The *Sesostris* Well Out Into the Breakers and Partially Waterborne

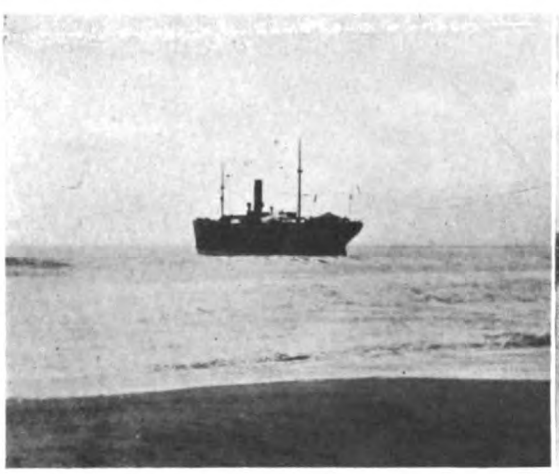

Fig. 15.—*Sesostris* (*Presidente Estrada C.*) Afloat at Sea

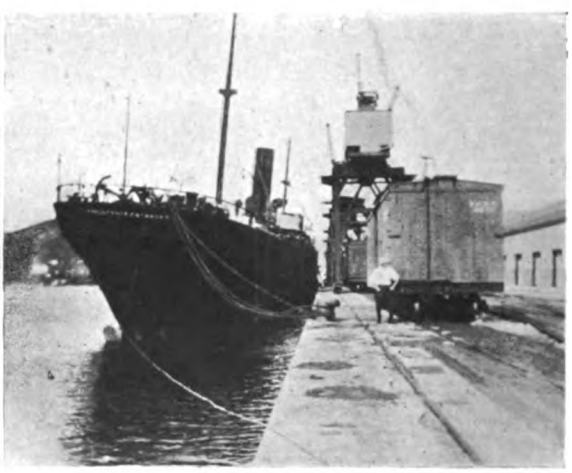

Fig. 16—*Sesostris* (*Presidente Estrada C.*) at Salina Cruz

Laying Out of Anchors

By December 4 four anchors had been laid offshore some 1,600 feet, and the cables, led through seven advantage tackles to the ship's own winches, fastened. The steel wire cables from the anchors were led to heavy steel blocks, which in turn were connected by 12-inch manila hawsers to every winch on the ship, thus distributing the strain over a number of points. An idea of the tension

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SALVAGING THE SESOSTRIS

Reclamation of Once Famous Kosmos Liner

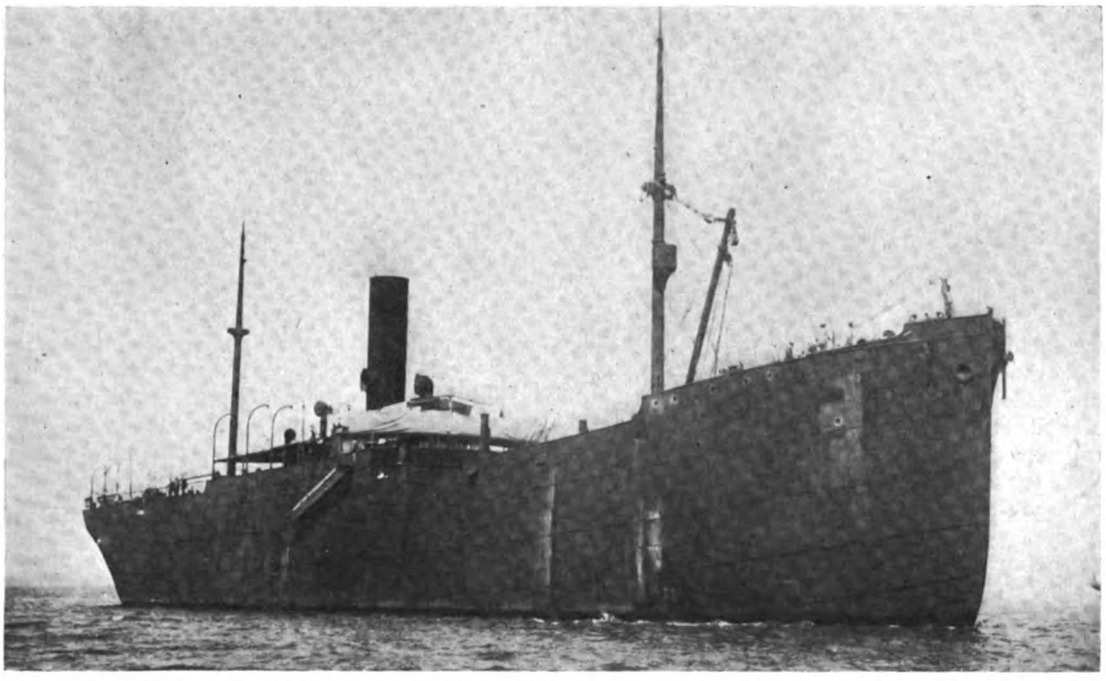

Fig. 17.—*Sesostris* (*Presidente Estrada C.*) Nearing Dock at Skinner & Eddy Shipyard, Seattle, Wash., Under Her Own Power

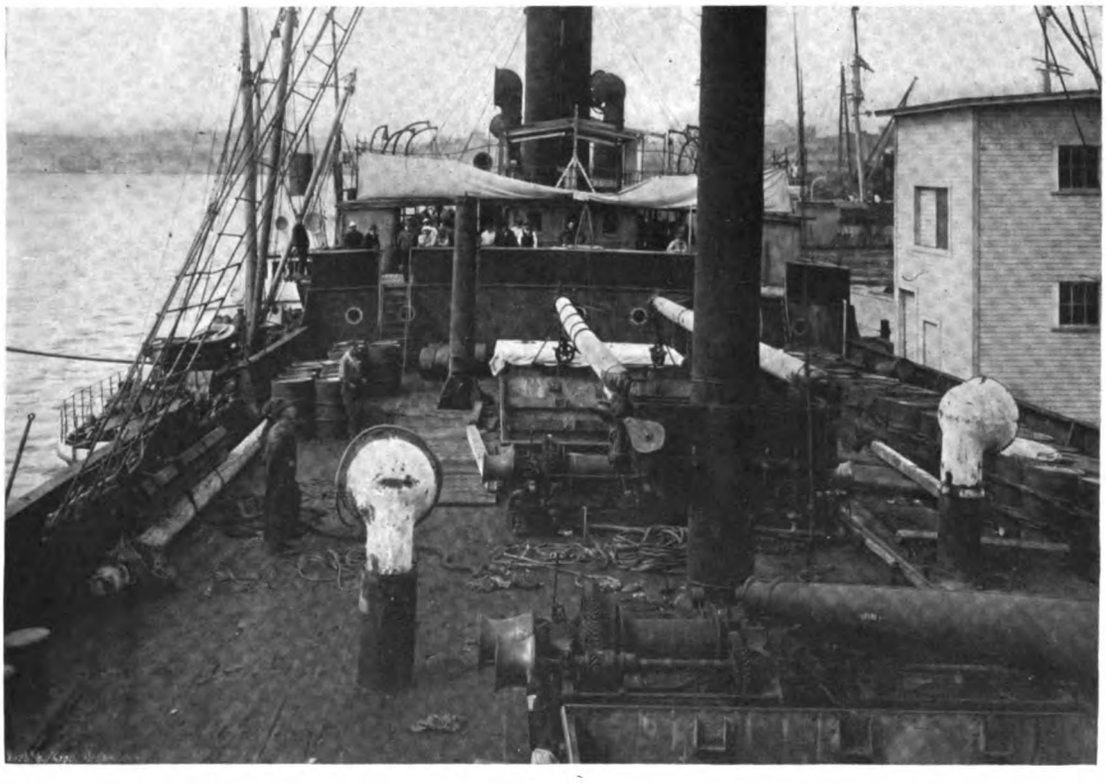

Fig. 18.—Deck View of *Sesostris*, Taken Immediately Upon Arrival at Seattle, Showing Almost Perfect Condition of Hull and Deck Fittings

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created in the cable may be obtained from Fig. 7, which shows the elimination of all sag and the general taut appearance.

The first movement of the vessel toward the sea was also accomplished on December 4. As the task still ahead consisted of dredging out forward of the ship and discharging aft, the pumps were then taken off the barge and sand and with the addition of another 10-inch pump, placed on a platform built in the square of the hatch in the orlop deck. Two holes were cut in the shell on either side of the bow to admit the suction tubing to be run out and the discharge was carried up to the 'tween decks and led through the bulkheads and then overboard.

Movement of the Ship Towards Sea

Progress continued until by December 29 a total movement of about 170 feet had been accomplished. On this day another series of setbacks occurred when one of the anchors lost grip and started to draw towards the ship, and on another line the tackle line collapsed, due to the strain in the cable.

In the meantime the heavy surf and strong currents were running and the breakwater was being continually undermined and battered down, necessitating constant attention and repair.

From December 29, 1916, until January 21, 1917, no advance in the movement of the ship was made, the time being spent in preparing the breakwater for better service and getting things in readiness for a quick drive toward the sea.

On January 22, with the help of a full moon and consequent high tide, a new advancement of 20 feet was made, and for six consecutive days a total advancement of 120 feet was accomplished.

The Breakwater Collapses

On February 1 a severe earthquake shock was experienced and the strong surf and currents showed their weakening effect on the breakwater, which again partially collapsed, but was replaced. This same series of events was repeated on March 5, when intermittent shocks, lasting throughout the afternoon, so weakened the breakwater that on the following day it completely collapsed and was abandoned.

It had, however, served the purpose for which it was intended, for the ship by this time had been hauled to such a position that at extreme high tide partial flotation was possible. Dredging out forward of the ship, however, still continued, and due to the partial flotation at high tide large advances were accomplished when intermittent swells made her waterborne.

Ship Finally Afloat

During the high tide of March 24, 1917, at 3.30 P. M., the *Sesostris* was finally floated, having been pulled seaward a total distance of approximately 500 feet. She was then swung to anchor and proceeded to Champerico on March 25, where she anchored in the harbor, having made the trip from Ocos without assistance.

From here the trip continued northward to San Diego, Cal., a short stop having been made at Salina Cruz for fuel, with the C. P. R. tug *Nitinat* as convoy. At San Diego coal was taken aboard and the trip to Seattle continued, arriving at Victoria, B. C., on May 14, and being convoyed by the tug *Salvor* from Victoria to Seattle, where she steamed up to the wharf of the Skinner & Eddy plant on May 16, the entire trip from Ocos to Seattle having been made under the ship's own power.

Survey Reveals No Disintegration

A thorough survey of the machinery and hull revealed no disintegration. The wood decks and deck fittings and very much of the exposed parts were, however, weathered to some extent and a complete cleaning and overhauling were at once given. New wood decks were laid, all fittings were made standard and brought up to date, and the general arrangement changed, doing away with all passenger accommodations and thereby increasing the cargo space. She is now engaged in Oriental trade.

The *Sesostris* was built in Flensburg, Germany, by the Flensburger-Schiffsbau-Gesellschaft in 1897, and was operated under the name of *Octavia* until she was bought by the Kosmos line, when the name was changed to *Sesostris*. This name she still carried on her ill-fated voyage, but shortly after the Skinner & Eddy Syndicate started to salvage her the name was changed to *Presidente Estrada C.*, in honor of the President of Guatemala. Upon being registered under the United States flag she was rechristened *Frances L. Skinner*, and by that name she will be known hereafter.

She is 378 feet 10 inches long, 48 feet beam, 29 feet depth and about 24 feet 7¾ inches load draft, with a deadweight of approximately 7,300 tons.

When drifted ashore she was bound from San Francisco to European ports via the Straits of Magellan.

The remarkable feature about this ship is the fact that on account of the good care she received at the hands of her owner, no serious disintegration occurred; but still she was left unhampered, no salvage company making any serious effort to reclaim her, though many attempts were made and considerable money spent before the Skinner Syndicate took the matter in hand and successfully accomplished the task.

The writer is indebted to Mr. Joseph Thebaud for the pictures and facts contained in this article, and to Mr. D. E. Skinner for permission for its publication.

Unique Method of Launching

THE 2,000-ton steamship *City of Tampa*, built by the Merrill-Stevens Company in their Jacksonville, Fla., plant, was recently launched in what is probably a a very unusual way for a ship of her size.

In building a ship of this size there was no available berth at the plant for launching in the usual method without great inconvenience and expense. The vessel was therefore built with level keel abreast the company's 4,500-ton floating dock, about three-fifths of her keel on solid ground and the balance on an approach pier to the dry dock. Before laying the keel extra piling foundations for keel and launching ways were put down, making the pier portion as solid as the ground part.

When the hull was ready to launch, the ground ways rollers and cradle timbers of a dismantled 1,200-ton marine railway from the company's South Jacksonville plant were utilized. The ways were laid under the vessel in the usual manner, but with only about one-twentieth inch pitch to the foot. The ground ways were continued from the pier to the dry dock and the alinement checked by four sights on each side, two on the dock and two on the shore.

The vessel was moved by means of a twelve-part ¾-inch wire rope tackle operated from the hoisting drums of the company's 1½-yard clam shell dredge which was moored against the farther end of the dock.

When all was ready the ground ways were brought into perfect alinement by trimming the dock with its pumps, and the vessel moved easily as soon as the strain was brought on the tackle. When about 50 feet of the stern of the vessel was over the outriggers of the dock, she was stopped and the dock compartments directly at the end

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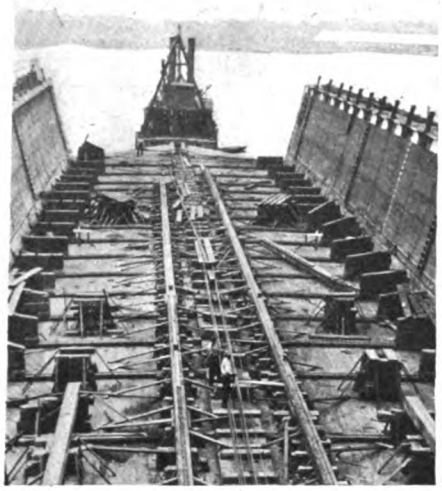

Fig. 1.—Dry Dock, Showing Tackle and Dredge in Position for Pulling

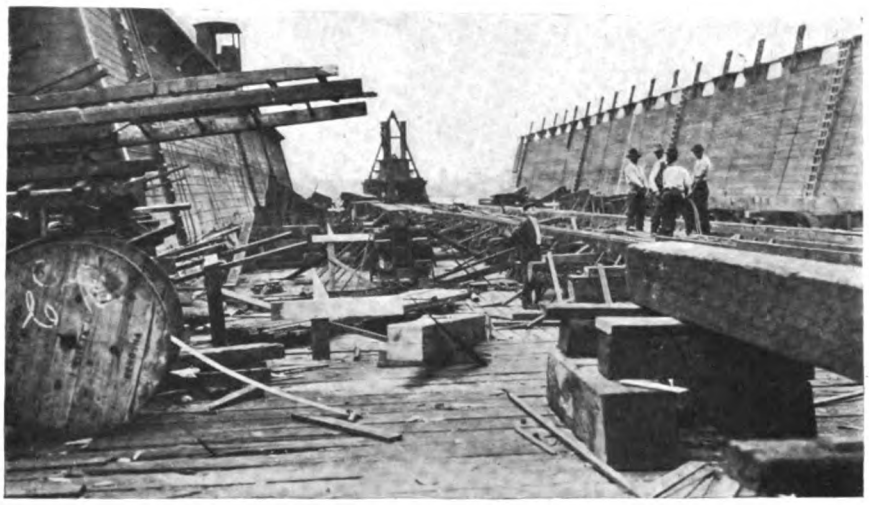

Fig. 2.—Dry Dock, Showing Sights Used for Checking Alinement of Dock, Also Dredge in Position for Pulling

pumped out until the ways were about ½ inch high. She was then again hauled about 50 feet, or until the sights showed about ½-inch sinking of the dock, then stopped until the pumping caught. This was repeated, more compartments of the dock being pumped as the vessel came over them, until in ninety minutes from the start she was entirely within the floating dock. She was then chocked and the ground ways connecting from the dock to the pier removed, and the vessel floated by sinking the dock in the usual manner.

The critical part of the operation, of course, lay in the fact that the vessel was moved off of solid ground on to a floating platform, which had to be kept adjusted to a constant alinement, despite increasing load from one end

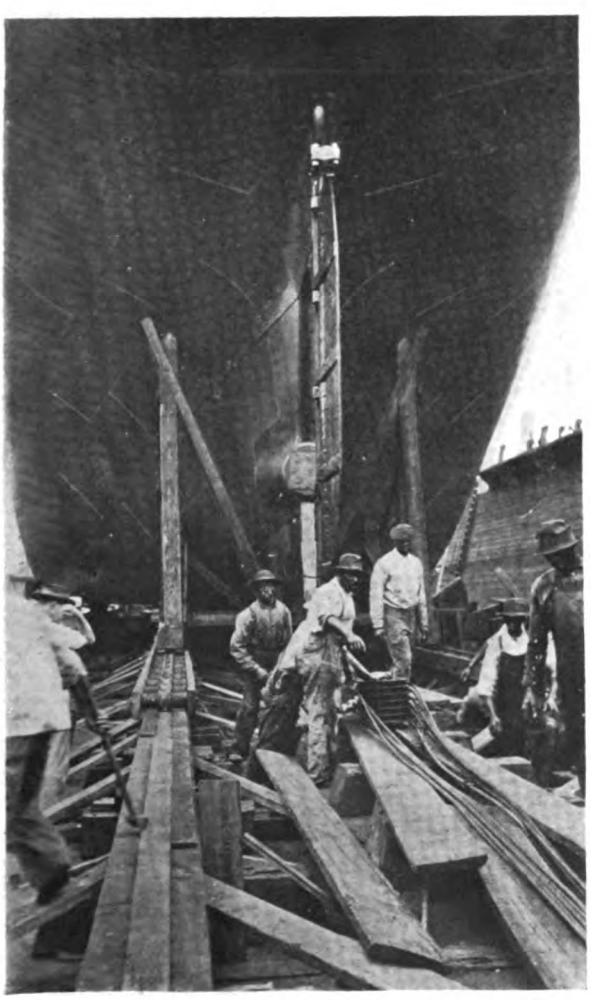

Fig. 3.—Placing the Tackle and Rollers in Position

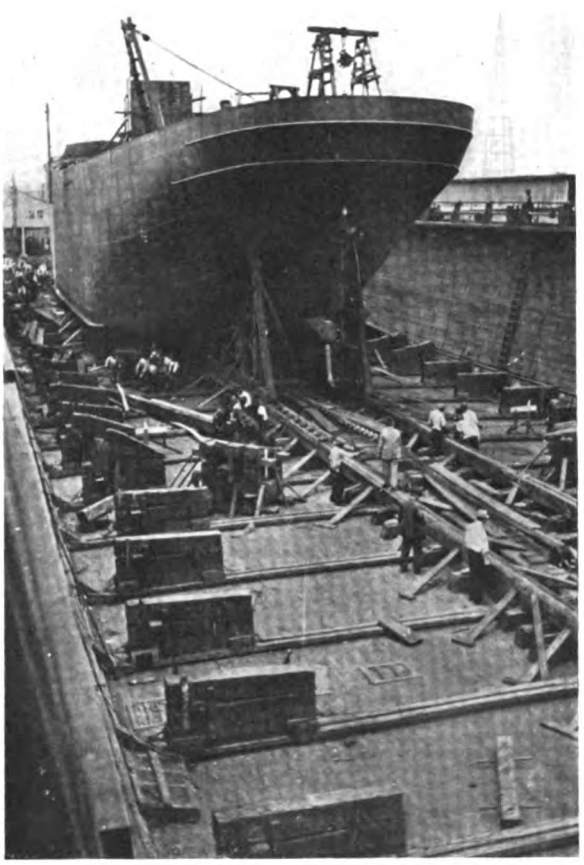

Fig. 4.—S. S. *City of Tampa* Partially in Dock

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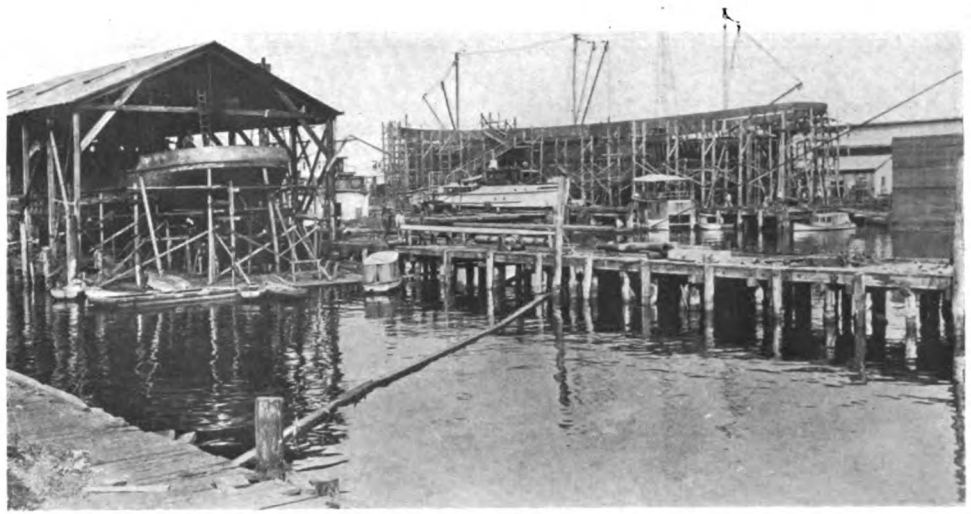

Fig. 5.—Where the *City of Tampa* Was Built, Showing Restricted Space for Launching

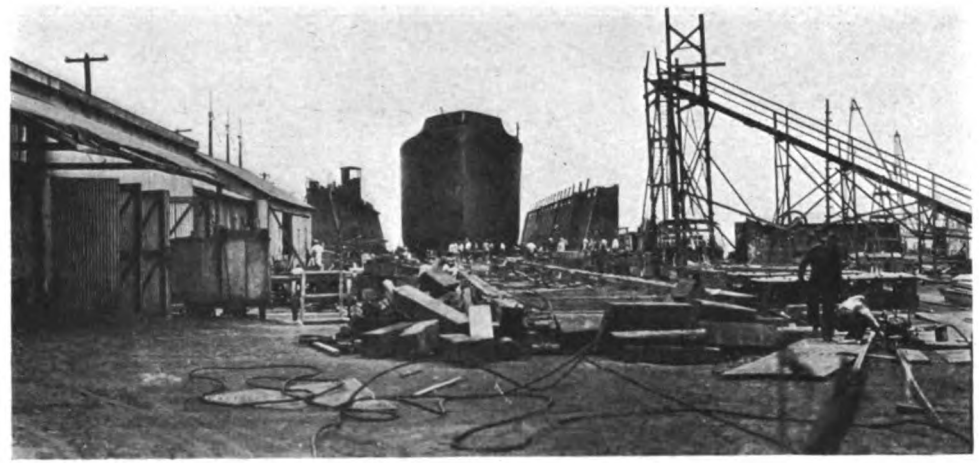

Fig. 6.—Vessel on Dry Dock After Transfer from Building Ways

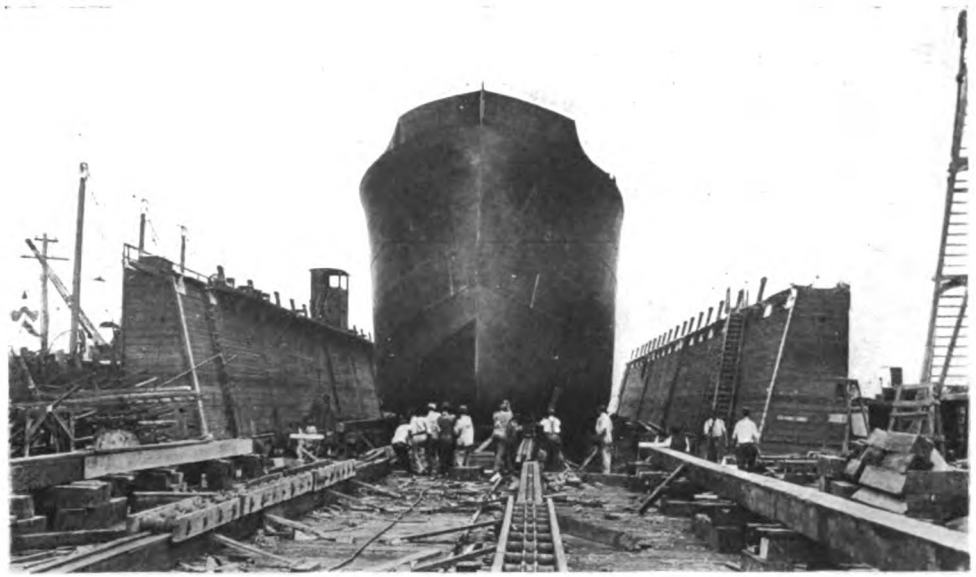

Fig. 7.—Gang Breaking Connection Between Dock and Ground Ways

Fig. 8.—The S. S. *City of Tampa* After Launching

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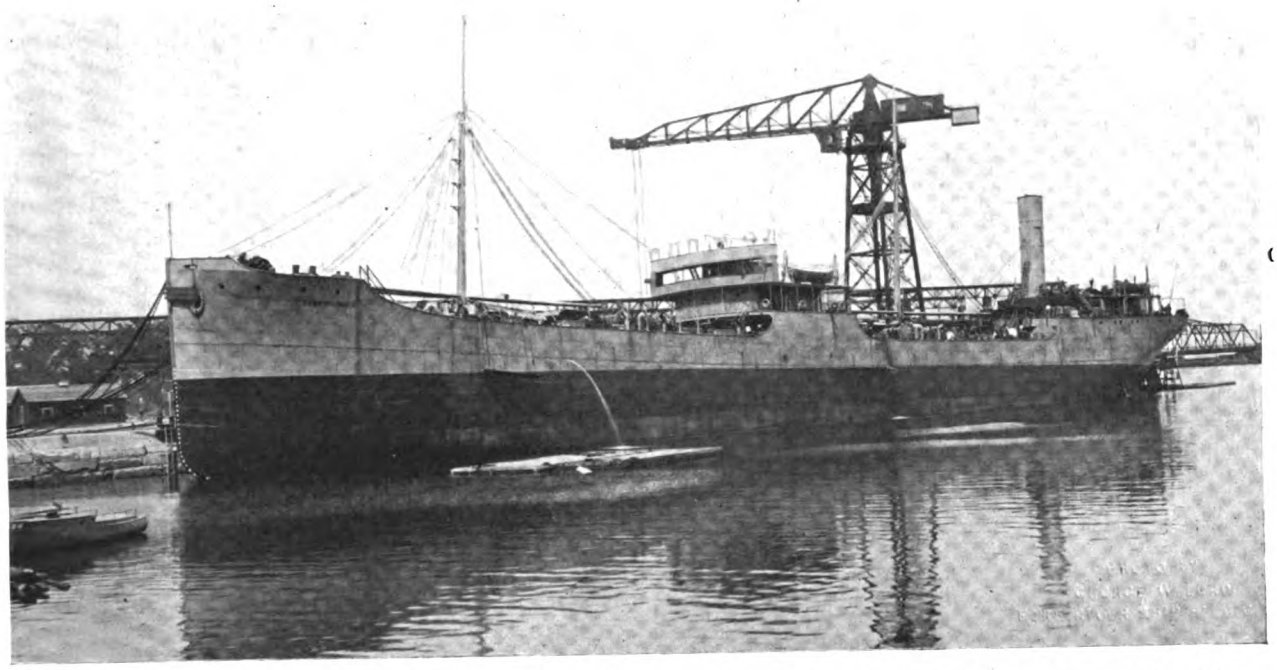
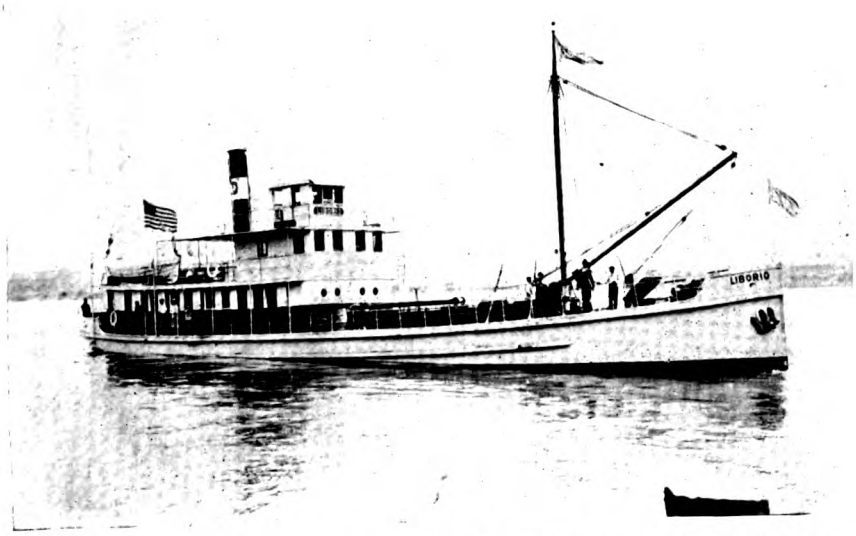


Oil Tanker *Pennsylvania* Built by the Fore River Shipbuilding Corporation, Quincy, Mass., for the Texas Company, New York. Launched on June 9 and Delivered to Owners on July 1

and changing tide level. This was made easily possible by the construction of the dock, the body of which is divided by steel bulkheads into sixteen independent compartments without interconnecting limbers, and each with its own sinking inlet and discharging pump. On this account it was not difficult to take up the weight of the vessel as she came over the dock by pumping the compartments directly under her. At the beginning only two end compartments were pumped, increasing as she advanced until at the final pull twelve were being emptied.

The operation was a perfect success, the vessel moving easily, showing no strain either on vessel or gear, nor at any time was the trim of her dock more than 1 inch out of perfect alinement. The actual pulling did not occupy more than fifteen or twenty minutes. The balance of the time was taken in stopping while the pumps were trimming the dock.

The *City of Tampa* is a hurricane deck, steel freighter, 221 feet long, 38 feet beam and 26 feet deep. Her keel was laid last September.



Twin-Screw Molasses Tank Steamer *Liborio*, One of Three Sister Ships Built by the Merrill-Stevens Company, Jacksonville, Fla., for the Cuba Distilling Company

Rush of Work at Fore River Yard

As an indication of the demand for carriers of all descriptions, and the pressure at which the Fore River Shipbuilding Corporation is now working to turn out the vessels it has under construction, the *Pennsylvania*, a tanker nearly 450 feet in length with a deadweight capacity of 9,100 tons, launched as recently as June 9, was on July 1 placed in commission and delivered to her owners, the Texas Oil Company of New York.

The Fore River Shipbuilding Corporation is steadily increasing its momentum. The number of men employed, working in night and day shifts, is gradually nearing the 7,000 mark and every facility is given them for the best of working conditions in every direction. President Joseph W. Powell states that in a few weeks he expects to have about 11,000 men, both skilled and unskilled, engaged in the yard.

In addition to merchant work there is under construction at this yard one-half of the submarines and one-third of the destroyers building for the U. S. Navy.

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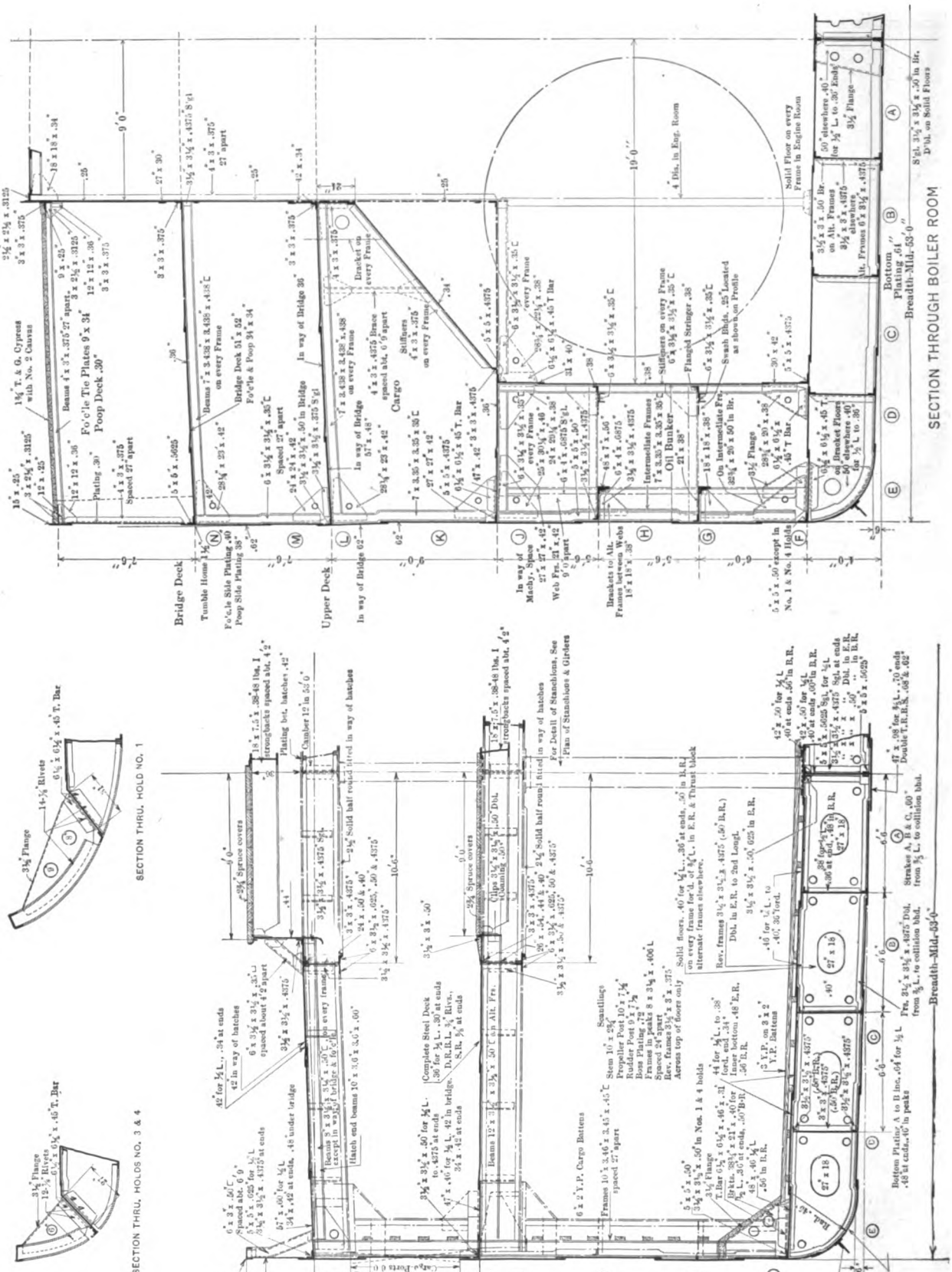

Fig. 1.—Midship Section and Section Through Boiler Room of Standard Steel Steamship for United States Shipping Board Emergency Fleet, Showing Scantlings

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Standard Single-Screw Steel Steamship for U. S. Shipping Board's Emergency Fleet

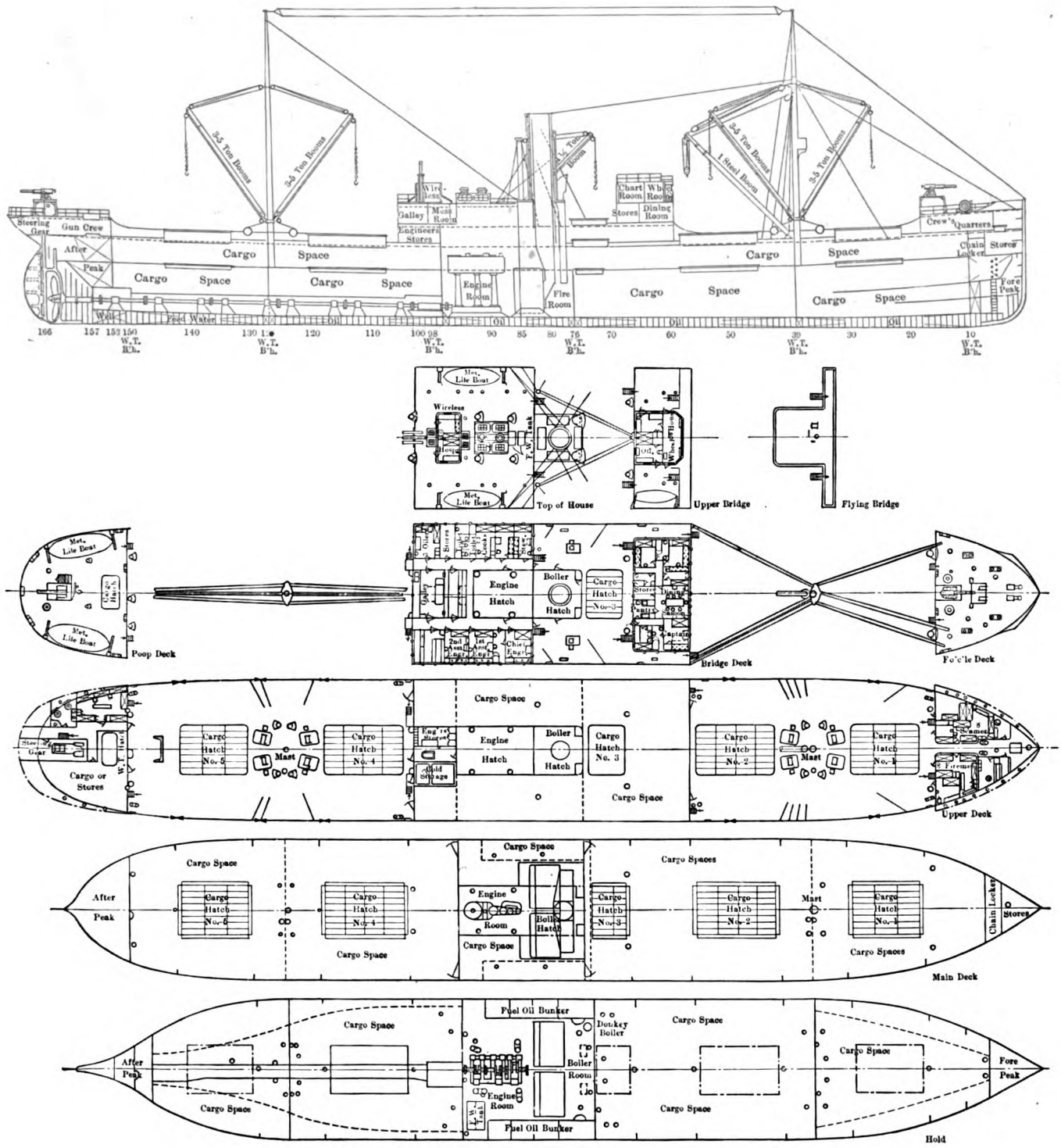

Fig. 2.—Profile and Deck Plans of Government Standard Steel Steamship

PLANS and specifications for a standard single-screw steel cargo steamer of 7,300 tons deadweight capacity and 11½ knots sea speed have been issued during the past month by the United States Shipping Board Emergency Fleet Corporation, in accordance with which the majority of the Government steel ships will be built. These plans and specifications have been worked out by the Shipping Board's naval architect, Theodore Ferris, 30 Church street, New York.

The vessel is of the single-screw type with straight stem and elliptical stern, schooner rigged with two steel pole masts. The hull is built on the transverse system

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with two steel decks and a raised forecastle, long bridge and a full poop. At the forward end of the bridge deck is a steel deck house containing the officers' quarters; and the top of this house is carried to the sides of the vessel to form the upper bridge deck, on which is located a wooden pilot house with a flying bridge fitted at the level of the top of the pilot house. There is also a steel deck house containing the engineers' quarters, etc., built abreast the engine casing on the bridge deck. A wooden deck house, containing a hospital and wireless room, is located on top of the latter house.

A complete double bottom, subdivided into five compartments longitudinally, is fitted throughout the length of the vessel. The compartments under the machinery space and under holds Nos. 1, 2 and 3 are arranged for storing fuel oil, while the compartments under hold No. 4 are arranged for feed water.

Six watertight bulkheads divide the hull into seven watertight compartments; four of the bulkheads extend to the upper deck and two to the main deck. Cargo is handled through five hatches in the upper and main decks and one cargo hatch in the bridge deck. There is also a hatch in the poop deck and one under it in the upper deck to the after peak. The hatches are all 18 feet wide: Nos. 1 and 5 are 24 feet 9 inches long; Nos. 2 and 3, 29 feet 3 inches long, and No. 3, 12 feet 8 inches long. Four cargo ports, each with a clear opening of about 7 feet 8 inches by 5 feet 8 inches, are also fitted on each side of the vessel between the upper and main decks.

For handling the cargo, three wooden booms of 5 tons capacity each and two single-drum, single-geared winches are fitted on each of the hatches Nos. 1, 4 and 5. For hatch No. 2 there are three wooden booms of 5 tons capacity each, one steel boom of 30 tons capacity, and two single drum compound geared winches. For hatch No. 3 there are two booms of 1½ tons capacity each and two single-drum, single-geared winches.

The principal dimensions of the hull are as follows:

Length overall, about	385 feet
Length between perpendiculars	370 feet
Beam, molded	53 feet
Depth, molded, to upper deck	30 feet
Designed load draft, about	24 feet
Sea speed, loaded	11½ knots
Tonnage coefficient, about	.78

The tonnage, according to American Bureau of Shipping dimensions, figures out as

Under deck	4,400
Superstructure	340
Superstructure	125
Total	4,865

General Arrangement

As can be seen from the plans, the machinery, which consists of a triple expansion reciprocating engine driving a single screw, is located amidships with two main boilers abreast and a screen bulkhead built around them at their after end to separate the boiler and engine rooms. Side bunkers for fuel oil are fitted below the main deck in the engine and boiler rooms, in addition to the double bottom compartments arranged for oil storage.

Accommodations for the captain, deck officers, engineers, etc., are provided in deck houses on the bridge deck. Quartermasters, boatswain, mess boys, seamen and firemen are berthed in the forecastle. Quarters for the gun crew with wash room are provided in the poop.

The vessel is equipped with an electric lighting plant of 15 kilowatts capacity, a refrigerating plant consisting of a 1-ton direct expansion ammonia machine, steam heating system, steam steering gear, steam windlass and steam capstan. For defense against submarine attack two guns are mounted, one on the forecastle and the other on the poop.

Hull Construction

The framing of the vessel is on the transverse system with two steel decks in the hull. The decks are supported by girders and deep beams with one row of wide-spaced pillars. The side frames are cut and bracketed at the main deck in way of the bunkers, so that the lower bunkers may be made oil tight. All scantlings are as indicated on the midship section.

The stem is a flat steel bar made in sections and the stern frame is of cast steel in one piece.

Complete steel decks are fitted on the main and upper decks, bridge and poop and stringers and tie plates on the forecastle. The main deck is carried through in way of the machinery casings and is oil tight over the bunkers.

In addition to the six watertight bulkheads, steel bulkheads are fitted at the forward and after ends of the bridge and the forward end of the poop and around the quarters in the forecastle. The galley and crew's mess room inclosures are of steel, as are also all bulkheads inclosing quarters in the forecastle.

Side bunkers are fitted in the engine and boiler rooms. A fresh water tank of 8,000 gallons capacity with two compartments is located in the lower engine room, fitted with all necessary filling and air pipes and necessary suctions.

Four 24-inch ventilators are fitted to the engine room and two 42-inch ventilators to the boiler room, with turning gear for the cowls. The quarters in the deck house and forecastle are ventilated by 8-inch ventilators. The cargo space is ventilated by sixteen 24-inch ventilators, while one 24-inch ventilator is fitted to the shaft alley and arranged to act as a means of escape therefrom. Two 10-inch ventilators are fitted in the poop for the cargo space and one 15-inch ventilator for the steering gear space.

Propelling Machinery

The propelling machinery consists of a vertical inverted three-cylinder, triple expansion engine with cylinders 24½ inches, 41½ inches and 72 inches diameter by 48 inches stroke, or a geared turbine of equivalent power, supplied with steam at 190 pounds per square inch from two single-ended, four-furnace, oil-fired Scotch boilers, or with steam at 200 pounds per square inch pressure from watertube boilers of equivalent capacity.

Steam from the main engine is exhausted into an independent cylindrical condenser having a cooling surface of about 3,800 square feet. The air pump is of the Edwards type, 26 inches diameter by 21 inches stroke, worked from the low pressure crosshead of the main engine, while the circulating pump is of the centrifugal type driven by a direct acting single cylinder engine 8 inches diameter by 10 inches stroke. The pump has a 14-inch suction and discharge.

Boilers

If Scotch boilers are installed they are to be of the single-ended four-furnace type, 16 feet 6 inches outside diameter by 11 feet 6 inches long, fitted with four 43-inch inside diameter Morison corrugated furnaces. Each furnace is to be fitted with an improved mechanical atomizing system for burning Mexican fuel oil.

The total heating surface of the boilers is about 6,300 square feet, and they are designed to steam in conjunction with a heated forced draft system. Watertube boilers

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of an approved size and type supplying steam at 200 pounds pressure may be substituted for the Scotch boilers.

For burning fuel oil, an approved mechanical atomizing system is to be used, complete with the necessary pumps, heaters, drainers, reducing valves, pump governors, burners and piping. Two fuel oil service pumps are piped so that they can draw from the fuel tanks and discharge through the heaters to the oil burners. One transfer pump is also provided for pumping oil from any one of the ship's tanks to any other tank or overboard. A small commercial type vertical donkey boiler, about 34 inches diameter by 6 feet 6 inches high, designed for a working steam pressure of 120 pounds per square inch, is installed for getting up steam and is fitted for coal burning.

Heater coils of 2-inch diameter standard galvanized wrought iron pipe are fitted in the inner bottom tanks under the engine and boiler rooms and 2-inch standard black wrought iron pipe in bunker tanks with 1-inch supply and drain pipes. A 1½-inch galvanized heater coil is fitted around each suction in the double bottom under Nos. 1, 2 and 3 holds.

Boiler Room Auxiliaries

The boiler room auxiliaries include a 60-inch steel plate fan direct connected to a 6-inch by 5-inch vertical engine. This is located in the engine room to supply air to the ducts to the air heater boxes for the forced draft system.

A 20-ton evaporator is installed with vapor connection piped to the auxiliary exhaust main. A feed water heater is also provided.

A feed and filter tank of about 80 cubic feet combined capacity is fitted in the engine room for receiving the main air pump discharge, the engine drains and the drains from the auxiliary condenser and feed water heater.

Engine Room Auxiliaries

An auxiliary condenser of 800 square feet cooling surface is installed in the engine room and connected up to the ballast pump discharge. The following pumps are provided:

Two feed pumps, 4 inches by 21 inches, attached one at each end of the air pump crosshead, arranged so that they can be worked independently.

Two bilge pumps, 5 inches by 21 inches, attached to the main air pump crosshead.

One evaporator feed pump, 1¾ inches diameter by 8 inches stroke, connected to air pump beams.

One fire and donkey pump, 9 inches by 6 inches by 10 inches vertical duplex.

One donkey feed pump, 4½ inches by 2¾ inches by 4 inches, horizontal duplex.

One ballast pump, 10 inches by 12 inches by 12 inches, horizontal duplex.

One fresh water pump, 4½ inches by 2¾ inches by 4 inches, horizontal duplex.

Why Is a Rivet?

What the Young Draftsman Should Know About Rivets and Riveting

TEK was getting out a plan for a cylindrical oil tank for a wooden steam schooner that we were fitting out. At the vault he had been given a plan of a fresh water tank of the same capacity and of about the right size for his job. He noticed that the longitudinal seams were shown double riveted and the circumferential seams single riveted. At first this puzzled him, but he remembered that riveted pipe is made this way because the stress on a longitudinal seam is twice that on a diameter.

$$\left(\frac{D \times L \times P}{2L} = \frac{DP}{2} \text{ and } \frac{\pi D^2}{4} \times \frac{P}{\pi D} = \frac{DP}{4} \text{ or } \frac{DP}{2} = \text{twice } \frac{DP}{4}\right)$$

Tickled that his technical training was bearing him out he confidently went ahead and finished up his new plan.

He was just about done when young Stevens happened along and commented on the neatness of Tek's tracing. The red and blue dimension lines and the red underlined lettering looked nice, he thought. Tek was flattered, and taking young Stevens into his confidence called his attention to the discovery he had made regarding the single and double riveted laps and demonstrated to him why this had to be.

"But, Tek," said Stevens, "this tank is not a pipe like you describe, because there is relatively no pressure on it except at the bottom. Besides, I heard the chief say the other day that all oiltight work had to be double riveted. This tank is to be used for oil, is it not?"

"Yep."

"Well, then, all the seams should be double riveted."

Tek's jaw dropped. He knew that to make double riveted laps would mean wider plates, or if he kept the same stock widths, then the diameter of the tank would have to be increased to keep the same capacity. That meant rubbing out a lot of colored lines, etc. He knew from past sad experience that the red ones would not come out entirely. Maybe it would be better to trace it all over again? When he had it all fixed up, would someone else come along and poke it full of holes? This was happening so regularly lately that he hesitated. He was losing confidence. Perhaps it would be well to get the fellow who would take the final kick at his plan to give some idea of the viewpoint from which he would criticise it.

Mac was coming down the aisle. Tek hailed him and meekly asked if he would take a look at his plan, and if he found any more mistakes he would then fix them all up at one time. Mac gave his plan the once over.

"Leave out the cement wash," he commented. "That is used in fresh water tanks to keep the water sweet. Oil is not sweet, and it would soon disintegrate the cement anyway. Show a flange for a vent. Make it the same size as that for the filling pipe. Change those ⅝-inch rivets to ¾-inch. Three-eighths-inch ends and 5/16-inch sides really require ¾-inch rivets, and it is the opinion of the majority nowadays that nothing less than ¾-inch rivets should be used for oiltight work. I know that the yard likes to use ⅝-inch rivets, and as a 5/16-inch plate is about the dividing line between ⅝-inch and ¾-inch rivets, we generally show ⅝-inch, but not for oiltight work. That

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manhole will not do, either. Show in our standard bolted plate manhole."

"Do you think it would be better to trace the whole over again?"

"No. You can change it quicker."

"But it will look like the devil."

"Nobody here in the office cares, and a blue print softens down a lot of awful hard-looking tracings. Go ahead and change it. Forget that it is a disagreeable job and you will be surprised how quickly it will be done. I see that you still have that colored ink masterpiece idea rooted in your head."

"There is one idea I have not got rooted in my head yet and it is one that is bothering me to beat the band."

"What is that?"

"This blamed ship riveting idea. I do not seem to get it right at all. I cannot keep awake at night long enough to read that new book 'Old Man of the Sea' loaned me. He says that is the last thing on riveting."

"Don't take 'Old Man of the Sea's' opinion for anything. He is a nut. Cut out this book business. You have mental indigestion. That is what makes you sleepy. If you wade clear through that stuff to the end you will find that it is necessary to assume a constant or coefficient that is no more rational or easy to guess than the result itself. Learn the result. Memorize it. It is not a hard job, and when you have mastered it you will have something that the yard understands and something that is acceptable to the classification societies. What is the use of pioneering over a rough road and floundering in and out of all the bad places when you can follow the signs and profit by the other fellow's sad experiences?

"When I started in I studied and worried about shearing resistance of rivets and bearing values of plates, etc. I packed pins and designed riveted joints that were never built, and when I got my first actual job for which I was paid real money I was at a loss to decide what size rivet to put through a ⅜-inch plate and a 3-inch angle bar. Most any apprentice in the yard can tell you offhand that this is a ¾-inch rivet.

Size and Spacing of Rivets

"I had not bothered with this shearing and bearing business for a long time until the other day, when that structural draftsman who was inflicted on us for a week tried to prove to me that four ⅞-inch rivets were enough for a certain stack casing bounding bar. I told him that the bar was only wide enough for a ¾-inch rivet, and that it had to be calked watertight, so that the rivets had to be spaced at most five diameters. This meant a lot more than four rivets. He said that if the ship ever sank as far as the stack, it would not matter whether the stack was watertight or any other kind of tight. I did not bother to tell him that a lot of calking is done in places exposed to the weather to prevent rusting and streaking of paint.

"As a draftsman, you are concerned mostly with the size and the spacing of rivets. By size I mean the diameter or nominal size of the undriven rivet. Of course, you know that the hole, and therefore the driven rivet, is about one-sixteenth larger than the nominal size. In other words, the hole for a ¾-inch rivet is 13/16 inch in diameter.

"Now the size is determined by the thickness of the plate or angle flange to be connected. This relation may have come out of shearing and bearing considerations; but be that as it may, our American Bureau, Lloyd's and Government rules clearly define the sizes to be used for different thicknesses of plate. I suppose that you know that the thickness of a steel plate may be expressed in different ways. The most common way is to speak of it as so many sixteenths. Lloyd's refer to it as so many hundredths. The American Bureau and the Navy Department refer to it as so many pounds per square foot, a 40-pound plate being about 1 inch thick. (If steel weighed 480 pounds per cubic foot and the rolls at the mill were absolutely stiff and did not roll the edges of a plate thinner than the middle, then this would be exactly true.) Here is a partial list of the common rivet sizes and plate thicknesses:

Rivet	Plate — In.	Plate — In.	Plate — Lbs.
½	¼	.32	10
⅝	5/16	.34	12½
¾	⅜	.48	20
⅞	9/16	.66	27½
1			

"The rules of these different authorities are not exactly the same, and when a ship is built the rules of the governing authority must be carefully and consistently followed. When there are two different thicknesses of plate to be connected the thicker plate will determine the rivet size when strength only is considered and the thinner plate will govern the size when watertightness is necessary. The plate edge may be likened to a beam the depth of which is the thickness of the plate and the span of which is the distance between the rivets. The stiffness of this beam makes calking possible. A thin plate under the long span of the larger rivets would not be stiff enough to calk.

"In inaccessible places tap rivets must be used. These are rivets with a countersunk head and threaded like a machine screw. They are screwed into a tapped hole by a small square shank on the head that is afterward sawed or chipped off. Because the thread weakens a rivet of this kind, it is customary to make them ⅛ inch larger in diameter than otherwise. Rivets ⅛ inch larger are used also where several thicknesses are joined on account of possible unfairness of the hole and to draw up the several thicknesses tightly together. Rivets in bar keels, castings, stems and sternposts are made ⅛ inch and ¼ inch larger for the same reasons.

"A rivet should not be located closer than a diameter outside of the hole from the edge of the plate. Closer than this would seriously weaken the plate. If the edge is to be calked, it will curl up if the rivet is located any further away than this. Planing the edge of bars and chipping actually brings the rivet a little closer to the edge than a diameter outside the hole. For oiltight work some of our tank-testing friends in the yard crowd in a little closer than this even. A diameter outside the hole, taking into account that the hole is 1/16 inch large, makes the plate edge 1⅝ diameters from the center of the rivet. Lloyd's give 1¼ diameters, but it is best for you to remember that for a ⅝-inch rivet this is 1 inch, 1¼-inch for ¾ inch, 1 7/16-inch for ⅞ inch and 1⅝-inch for 1 inch.

"For this reason and for the purpose of locating the head well in the flange, a certain flange width is associated with certain rivet size: 2½-inch for ⅝-inch, 3-inch for ¾-inch, 3½-inch for ⅞-inch, etc.

"Remember that this is all what is called good practice. It is not a result of definite analysis, but a sort of style of majority opinion that works. You can depart from these rules without the world coming to an immediate end, but it is easiest to follow them as closely as possible. The yard kicks when there are different size rivets in the same plate. It means changing the punch or rehandling the plate, and for this reason it is best to strain a point and if possible keep the rivets all the one size.

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"The distance from the center of one rivet to the center of the next one in the same row is called the spacing. The nature of the work and the location in the ship determines this spacing. Oiltight work requires rivets spaced 3 and 3½ diameters in plate laps and 4 diameters in shapes; watertight work, 4½ and 5 diameters. Spacing is given in diameters because in that way it applies to rivets of different sizes. All rules have tables that give the actual pitch or spacing in inches for the different sizes and diameters. Old Jerry had a negative made of one of these tables and got out some prints which he pasted on pieces of fiber of a good pocket size and distributed them among the fitters. If you want one, maybe he will give you one. Tackle him on his blind side, however, because he is a Tartar.

"In general, don't space rivets closer than 3 diameters nor farther apart than 8 diameters. When strength and not watertightness is required, space them 5 diameters.

"As to the width of seams, laps and straps, the best thing for you to do is to refer to the table of rules of the classification society you are required to follow. No general rule will cover the small differences that exist between the various rules, and although these differences are really unimportant they are definitely stated and, because they form part of the contract, must be followed. I make no effort to remember these distinctions, but resort to the rules when the point comes up. This is best for you also. When the time comes, do it deliberately and there will be no difficulty.

TYPES OF RIVETS

"As a draftsman you do not have to bother with the kind or type of rivet to be used. Rivet iron of the various sizes is ordered (as a percentage of the whole steel weight) and rivet machines turn out for stock the kind of rivet that may be required. A man driving rivets knows better than anybody else the length, etc., of rivet he wants. He gets what he wants, too. Watch a rivet gang working and you will soon decide to 'let George do it.'

"But there is one thing that you should know, however, and that is the proper shape of a rivet head and of the countersunk point, so that when you have to make a large scale drawing of some riveting detail, showing clearances, etc., your rivet heads will not look like toadstools or tacks. Roughly, a pan head is about three-quarters of a diameter high, the top is a diameter in diameter and the bottom of the head is about 1½ (1.6) diameters in diameter. For closer dimensions than these go to the rules. The angle of countersink for ¾-inch and ⅞-inch rivets is 45 degrees, 53 degrees for ⅝-inch and 37 degrees for 1-inch rivets, so that a convenient way is to cut or scratch a line bisecting one of the 45-degree angles of your triangle which you can use with another triangle by placing this line over the centerline of the rivet to draw in the sides of the countersink. For the ⅝-inch and 1-inch rivets a little more and a little less helps the appearance.

"With the expansion of the sphere of loft work that is going on in these times, the loft is taking upon itself more and more the work of riveting details. They should. A man who is making templets to full size, if he is competent, is in a better position to puzzle out rivet problems than a draftsman working to a small scale. Stopwaters, liners, quilting, or tack rivets can be handled best in the loft and the yard. That is the way it is done here in this yard, anyway, so you need not bother your head about them. A bulkhead liner or lozenge liner, as it is sometimes called from its peculiar shape, has to be figured. This is a liner that is fitted to an outside shell strake in way of a watertight or oiltight bulkhead. Some kind of a liner has to be fitted here, and usually one is so designed that by its shape helps to make up for the weakness caused by the close spacing of the row of watertight rivets. The idea is to make the strength or area through an inner and outer strake and the liner equal to the area through a row of non-watertight holes through the same strakes. It is just a little puzzle and a matter of cut and try.

"It is too near quitting time now to explain this further, and, besides, I have a car to catch. To-morrow we will take this up again."

Proposed Method for Safe Transportation of Supplies to Europe

Plans by which it is claimed supplies can be safely transported from the United States to Europe have been proposed by John L. Bogert, consulting engineer, New York. To accomplish this result, and thereby overcome the U-boat menace, it is proposed to ship the supplies in fleets of merchant vessels, each fleet consisting of four merchant vessels, convoyed by a specially constructed, unsinkable armed merchant vessel, equipped with aeroplanes for scouting and offensive purposes against hostile submarines. The success of this scheme would depend, of course, upon the amount of protection afforded by the specially designed unsinkable convoy ship.

According to Mr. Bogert's designs this vessel would be about 560 feet long and 80 feet beam, with a deadweight carrying capacity of 15,000 tons. The extreme width is accounted for by the fact that the vessel has practically a double hull, the space between the inner and outer hulls being thoroughly subdivided by longitudinal and transverse bulkheads into a cellular structure designed effectually to resist torpedo attack and thus render the boat unsinkable.

For offensive purposes the convoy ship is armed with rapid fire guns and is equipped with aeroplanes which can be maneuvered from the upper deck. To make this deck available as a landing stage and "take-off" it is extended for the entire length and width of the ship and is entirely unobstructed by any deck erections, funnels, masts, rigging or fittings. It is claimed that constant scouting with aeroplanes from the convoy ship would lead to the detection of the presence of hostile submarines and that the destruction of the submarines could be effected by bombs dropped from the aeroplanes or by gun fire from the convoy ship.

Assuming that the protection afforded by the convoy ship is effective, one such fleet with a deadweight carrying capacity of 50,000 tons could safely transport to Europe in a year 600,000 tons of freight and with ten such fleets the not inconsiderable amount of 6,000,000 tons of freight could be safely carried across the Atlantic.

WOODEN SHIP BUILT IN THE SOUTH PROVES SUCCESSFUL BLOCKADE RUNNER.—The three-masted schooner *Glynn*, the first ocean-going commerce carrier built in Georgia since the Civil War, and so far as known the first launched from a Southern shipyard since the revival of wooden shipbuilding in America, and the first Southern built vessel to take a cargo from an American port for Europe since the war began, has arrived safely at her port of destination in Europe. The *Glynn* was built by the Brunswick Shipbuilding Company, Brunswick, Ga. The keel was laid in March, 1916, and the vessel launched January 12, 1917.

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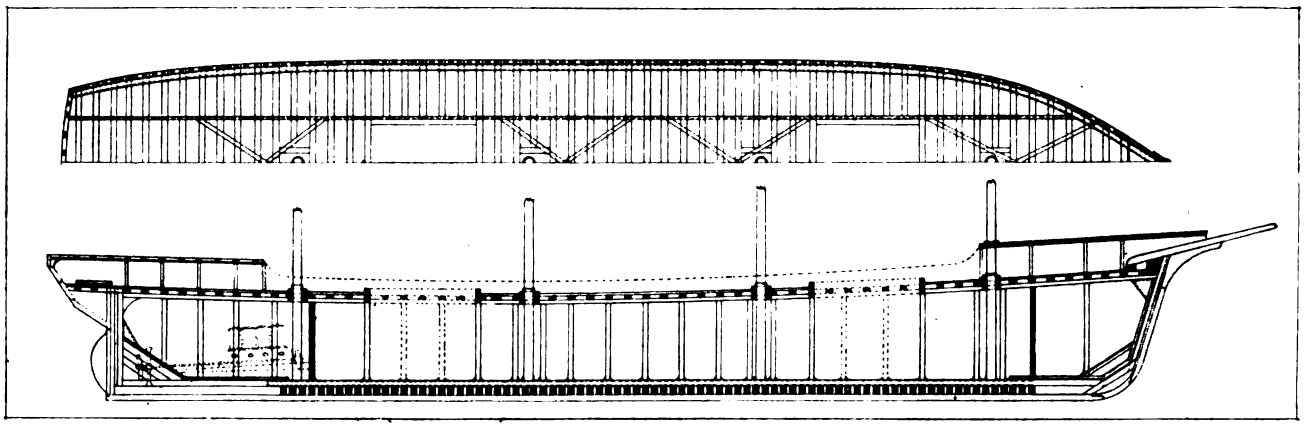

Fig. 1.—Profile of Auxiliary Schooner, Showing Steel Keelson

Special Composite Ship Construction

BY M. F. CARR *

Steel reinforcing in wooden ships is for the purpose of eliminating the heavy timbers in the old type of wood construction, and at the same time to retain the required strength. Past experience has shown that wood and steel form poor construction if great care is not taken in assembling and fastening the members. When connecting iron or steel to wood the bolt holes are from 1/16 inch to ⅛ inch larger than the bolt. The fastening, not being rigid, will work loose after the ship has been in operation a few years, causing the seams to spring and leak, if not developing other serious defects. This is also the main cause of hogging in wooden ships, the greater strains being longitudinal, causing the keel timbers to loosen at the joints and spring.

Figs. 1 and 2 show a special method of reinforcing in a four-masted auxiliary schooner. This method differs from other types in that all steel work is riveted independently of the wood, so as to avoid strains in wood fastening. The keel is constructed of heavy channels running from the forward to the after peak bulkheads, the ends being connected to the stem and stern post with angles. The wooden keel is fastened to the channels with 1-inch bolts. The side, or floor plates, are fastened to the floor timbers with lag bolts and connected to the top and bottom channels with angles.

The top channel or center keelson consists of three 15-inch by ½-inch channels, riveted to the floor plates and also to the flanges. A ⅜-inch plate is riveted to the standing channels, as shown in the drawing. The intercostal channel between the frames, which can be made of any width to suit the frame spacing, is also riveted.

All of the steel work is riveted before the wood is fastened. The reinforcement of the bilge is made up of angles, small plates being connected to the angles at the ends and joints of the futtocks. At the lower and upper turn of the bilge two channels riveted to the angles run longitudinally, forming a girder, as shown in sections *C-C* and *D-D*. The section shown at *A-A* and *B-B* is the alternate frame where the angles are omitted and short channels are used to connect the longitudinal channels.

The brackets or beam knees are made from plates flanged and fastened with 1-inch bolts through the frames and beams. The channels at the deck, shown in detail, are riveted to the brackets. Trusses, as shown in cross section, are placed under the beams and connected to the

* Naval architect, 258 Broadway, New York.

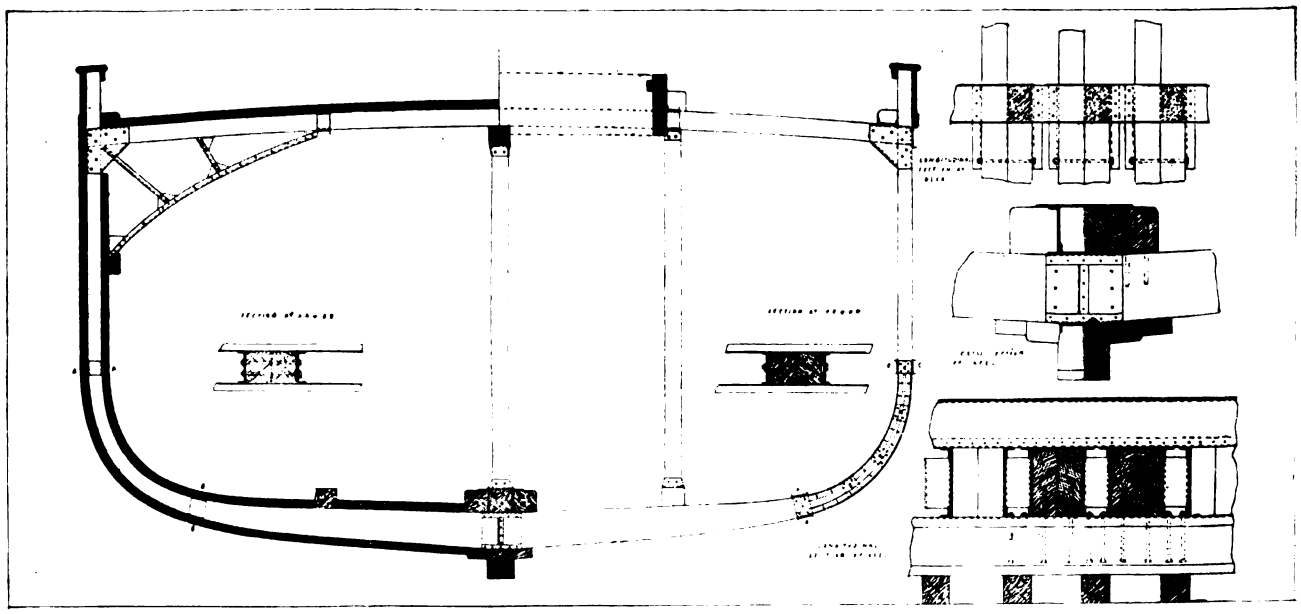

Fig. 2.—Cross-Section of Four-Masted Auxiliary Schooner, Showing Steel Reinforcing

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side stringers in order to take the place of hold beams. These can be spaced 12 or 15 feet apart, so as not to interfere with the stowing of cargo. The channels shown in the deck plan run the full length of the ship and are of the same construction as the sections at *A-A* and *B-B*. Tie plates run diagonally and connect to the longitudinal channels.

According to this design, all work can be assembled and riveted without difficulty. Templets for the work can be taken from the mold loft, which will insure accurate work and will also fair the frames and beams. Plates can be used instead of channels for this type of construction, but at the present time structural channels are cheaper and more easily obtained.

For a vessel 250 feet long about 120 tons of steel would be required, and the cost would be about $6,000 (£1,230) or $7,000 (£1,435) more than that for an ordinary wooden ship. The saving in cargo space, however, would be nearly 300 tons, and this advantage would be obtained at a much less cost of upkeep. Ships 300 feet long can be built according to this method with perfect safety. In Fig. 3 is shown a midship section for a ship of 3,600 tons deadweight carrying capacity of the following dimensions:

Length overall.....290 feet
Length between perpendiculars.....276 feet
Beam over planking.....43 feet 6 inches
Depth, molded.....25 feet 6 inches
Diseplacement at 22-foot waterline.....5,550 tons

The method of construction is similar to that of the auxiliary schooner with the exception of the bilge and sides. There are three strakes of longitudinal channels fitted to the bilge instead of two. Plates are used on the sides and decks in place of channels. The beams, bulkheads and hatches are of steel construction. There are 7/16-inch plates bent or cut to the shape of the frames and fitted between timbers and extended from the lower to the upper turn of the bilge. Every hold beam extends to the brackets. This method of bilge construction has no special advantage over the angle type and is used only as a matter of choice.

The longitudinal channels shown at the bilge run the full length of the ship and connect to the stem and stern posts. They are connected to the frames with flange plates. There are two strakes of plates fitted to the sides at the hold beams, and an upper deck running the full length of the ship connected with the stem and stern posts. There are also two strakes of plates, one on the upper deck at the side, and one on the hold beams at the side known as stringer plates in steel ships. These plates run the full length of the ship and connect to the side plate with angles.

The brackets at the hold beams are beam knees flanged to the side and fastened to the frames with inch bolts.

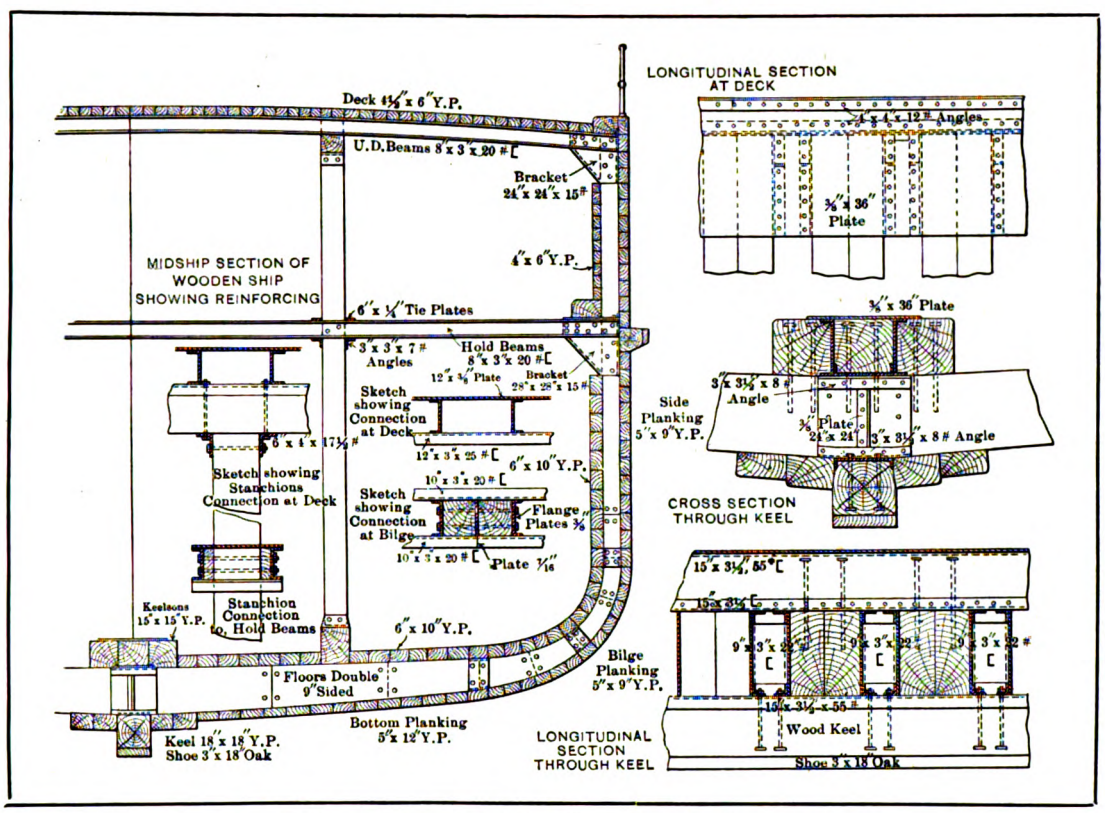
LONGITUDINAL SECTION AT DECK
Deck 4½" x 6" Y.P.
U.D. Beams 8" x 3" x 20 # [
Bracket 24" x 24" x 15#
4" x 6" Y.P.
MIDSHIP SECTION OF WOODEN SHIP SHOWING REINFORCING
6" x ¼" Tie Plates
3" x 3" x 7 # Angles
Hold Beams 8" x 3" x 20 # [
12" x ¾" Plate
Bracket 28" x 28" x 15#
Sketch showing Connection at Deck
6" x 4" x 17½ #
12" x 3" x 25 # [
6" x 10" Y.P.
Sketch showing Stanchions Connection at Deck
10" x 3" x 20 # [
Sketch showing Connection at Bilge
Flange Plates ⅜
10" x 3" x 20 # [
Plate 7/16"
Keelsons 15" x 15" Y.P.
Stanchion Connection to Hold Beams
6" x 10" Y.P.
Floors Double 9" Sided
Bilge Planking 5" x 9" Y.P.
Bottom Planking 5" x 12" Y.P.
Keel 18" x 18" Y.P.
Shoe 3" x 18" Oak
LONGITUDINAL SECTION THROUGH KEEL
3" x 3½" x 12 # Angles
⅜" x 36" Plate
⅜" x 36" Plate
3" x 3½" x 8 # Angle
Side Planking 5" x 9" Y.P.
⅜" Plate 24" x 24"
3" x 3½" x 8 # Angle
CROSS SECTION THROUGH KEEL
15" x 3½" 55 # [
10" x 3½" [
9" x 3" x 25 # [
9" x 3" x 22 # [
9" x 3" x 22 # [
15" x 3½" x 55 #
Wood Keel
Shoe 3" x 18" Oak

Fig. 3.—Cross-Section of Wooden Steamship with Steel Reinforcing

The upper deck brackets are fastened the same as the hold brackets.

The beams are 8-inch by 3-inch by 20-pound channels. The upper deck beams have a camber of 10 inches, while the hold beams have no camber and are spaced about 10 feet.

The bulkheads are constructed according to requirements of the American Bureau of Shipping and are connected to the center and bilge keelsons with steel brackets riveted with ¾-inch rivets. The hold and deck stringers are continued through bulkheads and connected with angles to bulkheads. The connection of the bulkheads to the hull is by double angles.

WEIGHT OF HULL

	Tons
Wood	1,050
Fastenings	90
Steel, including rivets	345
Total	1,485

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Shipbuilding Accidents*

Hazards to Which Workmen in a Shipyard Are Subjected—How They May Be Mininized or Eliminated

THE accident history of American shipbuilding closely follows that of European countries, where the industry has a high rank among dangerous occupations. A little study of the conditions under which modern shipbuilding is carried on will show why the accident rate is so high, and a little further study will show that many of the accidents are wholly unnecessary.

Many of the operations in the modern shipyard, where steel is the chief constructural material, are quite different from those that were in vogue in the good old days of the wooden "wind-jammer"; but the changes that have been made have not greatly altered the nature of the hazards to which the men are exposed, and most of the injuries are still due to falls, or to blows from falling objects.

The details of shipbuilding vary from yard to yard, according to the magnitude of the operations, the age of the plant, and the experience and personality of the owner or manager. We believe, however, that the practices and suggestions outlined below are fairly applicable to average yards and conditions.

Blocks for supporting the keel are first placed on ground previously prepared, and supports for a scaffold or staging are then erected around the entire space to be occupied by the ship. From an accident-prevention standpoint the staging is one of the most important things in shipbuilding, because a great deal of plate-erecting, riveting, calking and painting must be done from it. In the commonest method of staging construction two parallel rows of uprights are set in the ground a few feet apart, each upright being provided, from top to bottom, with a series of holes through which bolts may be passed. The bolts support horizontal wooden stringers or cross-pieces, upon which the plank platform of the staging rests. As the work on the ship progresses, the bolts are usually shifted to higher holes and the platforms raised to new levels, though sometimes the old platform is retained and a new one is laid higher up. (In some yards special stagings with metal supports are used, but the safety problem is much the same.)

In many shipyards the men who work on the staging are paid by the piece or area system, and they must raise or lower the staging platforms themselves. As the shifting of a platform is unremunerative work, it is performed as quickly as possible, and not always with safety in mind. In fact, the accident rate from poor staging became so high at one time that a number of shipbuilding companies have placed their staging work in charge of men specially trained to it, nobody else being allowed to move the platform nor to alter the structure in any other essential way. This plan has worked out very well, largely because these men realize that they will be held responsible for all accidents due to faulty staging.

One specially marked feature of permitting or compelling the regular workmen to maintain their own staging is the propensity of such men to use timber and planks that are worn out or badly damaged, or defective in some other way, instead of taking the time and trouble to procure sound and suitable material. Planks and timbers that are seriously warped, split, or otherwise badly damaged should be sawed up or removed from the premises, in order to prevent improper use being made of them. A responsible staging gang, knowing what constitutes a safe working condition and what they have on hand to meet certain requirements, is far less likely to use unsuitable materials.

Men working on a staging often fall from the back of the platform—that is, from the edge that is away from the ship. It is easy to prevent an accident of this kind by erecting a stout railing along the outer row of uprights,† but the railing has been quite generally omitted, mainly because of the time required to install it and remove it. This objection, which is as old as scaffolding itself, is not a sound one, because the gain from using the railing is out of all proportion to the trouble and expense involved in putting it up. The man who thinks it is not worth while takes this view because he is sure he will not have an accident; but it is a matter of common knowledge that accidents of this kind occur every little while, and it is much better to be safe than to be sorry. In fact, being sorry doesn't do anybody any good.

Outside Staging

In some yards plank shelves are put up in the place of guard rails. This is a good plan, because a strong and properly located shelf affords protection to the men, and it can also be used for the storage of tools, rivets, bolts, paint cans, brushes and small material of all kinds. The shelf should be guarded by a board on each edge, however, to prevent objects resting upon it from falling off.

The platform planks of ship stagings should be laid with special care. To avoid all chance of tipping, they should never be allowed to project at their ends more than a foot beyond a firm and solid support, and the men who have charge of the laying of the platforms should make sure that there are no "traps" or points at which the planks can tip between supports, so that the men can fall through the platform to the ground.

The platform planks of ship stagings are seldom secured to their supports except at points where considerable work must be done without disturbing the staging. This is because the men desire to avoid the extra labor involved in shifting the platforms when the planks are fastened down, and also because it is often necessary to move some of the planks nearest the ship, to facilitate the hoisting of plates and other materials into place. The fastening of the planks is far more important in connection with ship scaffolding than it is in connection with the building of an ordinary brick wall, because the jar of the riveting machines and hammers may cause the planks to shift or "creep" until they come into dangerous positions, even though they were correctly placed at the outset. It is well worth while to strap or clamp them to their supports, or to make them secure in some other equally effective way. One method that has been tried with considerable success consists in boring holes through the ends of the planks and through the cross-bars or stringers that support the platform—the cross-bars being made extra wide in this case to allow for the weakening due to the holes. When a plank is laid down, it is placed so that the hole in one end of it comes directly over a hole in the support-

* From *The Travelers Standard.*

† A foot-board should also be used, and wire netting between the two is strongly recommended in addition.

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squarely in the face—get down to real work and you will wonder why you did not see things this way before.

Some fellows ask: "What more can I do? I've passed the exams and got my ticket. I've worked hard, and still I don't get a show." That may all be true, but your ticket is only a bit of evidence to satisfy the law that you are competent to safely handle the boilers or to take a watch below.

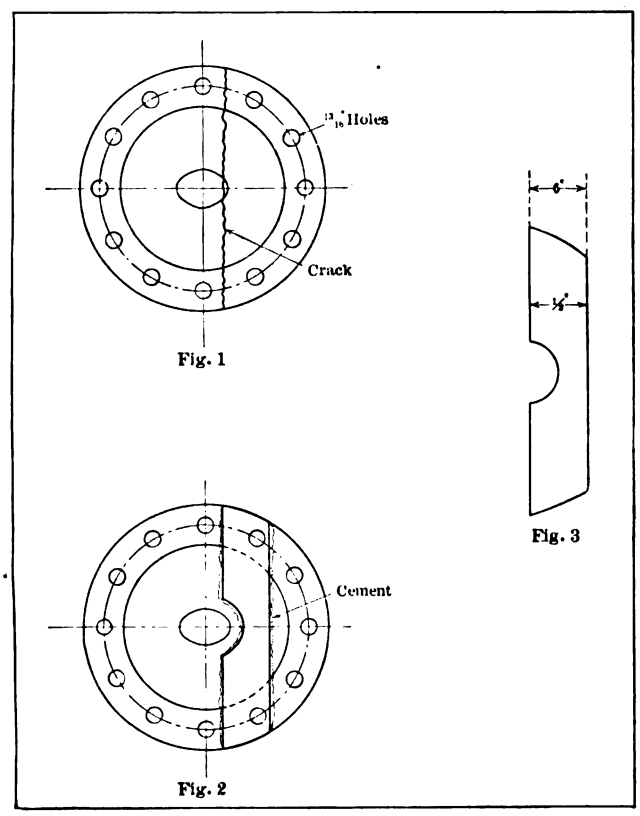
These are days of efficiency—you hear the cry everywhere, efficiency. Entertain no thought of failure, of defeat. You must like engineering or you would not be in the business, therefore develop your talent and use it in proving your worth. Mayhap someone is taking your measure.

CHIEF.

Pump Repair

The cover of our general service donkey pump at the water end developed a crack across the face of the cover, as shown in Fig. 1. As the crack was causing a great loss of water, it was decided to repair it at once.

The repair consisted in securing a piece of plate ½ inch thick by 6 inches in width of a length equal to the diameter of the cover. After checking it out on the center so as to allow it to be fitted hard up against the stuffing box, to insure it being a good fit, two of the ¾-inch studs were drawn because they were too short by the extra thickness of the plate.



Details of Repair to Cracked Cover of Donkey Service Pump

The studs were replaced by longer ones and a good thick coating of cement was made up and liberally spread over the cover, particularly over the cracked portion of the cover. A handful or two of dry cement was then sprinkled over the wet cement, and the plate, Fig. 3, was carefully put on and the nuts screwed down by hand only until the cement had remained some little time to harden. The nuts were finally tightened down with a spanner.

The pump was first started under easy steam until the cement was properly hardened, after which the pump was put to work in regular service. No further trouble was experienced with the cracked cover, although the chief ordered a new cover, which, however, was not put on until after the writer had left the ship.

Sidney, N. S. W. A. L.

Jack Smith, Tramp Engineer

Generally speaking, the tramp was not much on education. He just managed to get his ticket as third assistant after the third time up by being coached and borrowing a few books, the kind supposed to fit a fellow to pass the license examinations. After "copping" his bit of paper from the examiners, he managed to dig up a berth on a tramp sailing for Calcutta.

Of course, there was a lot the tramp didn't know about marine engineering, but he had done nearly everything from stowing bunkers, firing and oiling, and had a pretty good knack for being handy and helping on repairs, etc. So he got along O. K. on the tramp, and began to assume the air of a full-fledged throttle twister.

When he got into an argument or was cornered by any of the ship's force, he would up and tell 'em that "he knew what he knew from practical, everyday experience; he weren't no book-learned engineer, and that none of those kind could slip him anything when it come to using a bearing scraper or coal scoop. Anyhow, there ain't nothing to engineering but to keep the stuff together so's you could keep the screws turning."

One day when Jack relieved the second assistant at four o'clock for the dog watch, he was told to watch the beam air pump (direct connected to the engine), that it was kicking up pretty much and the vacuum had been dropping.

Along about ten or twenty minutes after he took the watch there came a slam-bang noise from the condenser. Jack beat it around the engine four bells ahead and found her mighty hot, and the circulating pump racing pretty fast, with the oiler looking scared to death. It did not take long for the tramp to decide that the engine had to be stopped or the condenser would be put entirely out of commission. Signaling the fireroom and bridge, he stopped the engine and chased the engine room striker after the chief. In the meantime he hunted for the trouble. The first thought he had was that the suction, or intake, was fouled on the ship's side. To clear it by closing the suction valve and blowing it out with live steam was decided upon. After this was done the condenser cooled, but when the engine was started again it soon heated and the circulator had to be run at top speed. The tramp then told the chief that he thought the vane or impeller wheel of the circulating pump was adrift, as the circulating engine seemed to run unbalanced. The chief told him this was impossible, but after hunting everywhere else it was decided that the tramp was right.

To remove the impeller casing and make repairs seemed almost out of question, and then the tramp suggested that they remove one of the lower condenser manhole plates and allow the water to back down through into the bilge, and then pump it overboard with the bilge pumps. The chief thought he was crazy, but they finally decided to try the scheme and make as much speed as possible. Accordingly, the overboard discharge was choked down to three-fourths opening, and the center bottom manhole

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plate of the injection end was removed and the floor plates taken up near it. The shaft bilge pump and both engine room and fire room bilge pumps were put on the bilge, the engine started and run at twenty-five turns. This gave 6 knots speed. Some trouble was at first experienced with strainers of the bilge pumps getting choked, and they were required to slow and stop a few times to keep the level down, each time shutting the overboard discharge valve of the condenser until the bilge level was reduced. After a few hours of patient efforts, they were able to make a standard speed of 5 knots, and when they arrived at port they all took their hats off to Jack Smith,

C. H. WILLEY.

"Inspect the Feed Pipe"

I was much interested in reading in the June number of MARINE ENGINEERING the article by C. H. W. entitled "Inspect the Feed Pipe." It recalled to mind an experience of slightly similar nature which I had with B. & W. boiler feeding, minus the exhilarating thrills one must experience when being chased by a submarine and standing a good chance of being overtaken mainly through lack of sufficient water in the boilers.

The good advice given by C. H. W. on the need of inspecting the internal feed pipes is well worth heeding. To facilitate this work, I call attention to the double flanging of the extreme end of the internal feed pipe, referred to further on.

My experience was with a certain vessel equipped with B. & W. boilers. I was troubled a good deal with the water in the gage glasses fluctuating at uncertain intervals, sometimes disappearing altogether for a minute or more. These boilers were filled with purifier drums, one on each boiler mounted above the steam drum. The feed checks were flanged to one end of the purifier, the water emptying just inside through a short nozzle. No internal feed pipe was used. The boilers had been operated in this way for several years. On being satisfied that the fluctuating conditions were mainly due to lack of a properly fitted internal pipe, I had such a pipe installed, and to make provision for readily inspecting and for cleaning the same, I fitted a pair of 6-inch flanges at the extreme end of it, one flange being screwed to the internal pipe, while the other was secured with suitable bolts, thus closing the end, which, being located just within easy access from a manhole plate, could be removed and flushed out when the boiler was being cleaned.

The plan more than came up to expectations. Not only did the fluctuation of the water level end entirely, but the supplying of boiler feed could afterwards be regulated to even and constant work—in fact, the control was made almost automatic.

J. A. MCVAY, Chief Engineer.

BOOK REVIEW

WHARVES AND PIERS: THEIR DESIGN, CONSTRUCTION AND EQUIPMENT. By Carleton Greene, S. B., C. E. Size, 6 by 9 inches. Pages, 248. Illustrations, 154. New York, 1917: McGraw-Hill Book Company, Inc. Price, $3.

REVIEWED BY H. MCL. HARDING *

This book is an aid to the designer in connection with the preparation of plans for the construction of quays and piers. There are only a few books in English available on terminal and harbor engineering and articles on these subjects are so scattered through the reports of societies and technical publications as to make it difficult to find them. The writer has assembled much of this information into one volume of ready reference, and it may be called the first book of its kind published in the United States.

The descriptions of the timber construction of the substructures of piers and quays will well repay careful study. As timber has been used extensively in this country because in the past it afforded a cheap material for construction, there are given many samples of different designs, but, as the author says, timber is liable to destruction or decay, marine animals and fire. Many of the earlier piers were constructed of wood by private owners and permanency was not the essential feature. Municipalities are now constructing, owning and operating marine terminals. Wooden substructures above mean low water are not now considered the best practice, and concrete will be used even more extensively than at present. The relative advantages of different kinds of piling, wood, concrete and combination piles are fully discussed, and from the data given the engineer can form a correct judgment as what to use in the problems met with in his practice. In general it may be said that the conclusions point to the use of concrete for the substructure wherever the financial and other considerations will permit. The section "Concrete vs. Timber" and the table of comparative costs will be found of practical service.

Data are given as to width of piers and the sustaining capacity per square foot. Retaining walls for piers and quays are illustrated fully, and this is the most valuable chapter in the book. The use of rip-rap and the limitations of crib work, with numerous examples, are also included under the heading of retaining walls. Views of cross-sections of many such walls are selected from existing harbor work on rivers, lakes and canals, and references are often made to the work of the New York Barge Canal Engineers. From a study of these, the extensive use of concrete is evident. Timber will be used only for temporary work or where the first cost is the chief consideration. The description of relieving platforms emphasizes the great advantages of this type of construction in respect to saving in construction and in long life.

The discussion on sheet piling construction leaves nothing to be desired. The question which always occurs to terminal engineers after the local conditions are fully understood—"What kind of a pier shall I design?"—can be answered by a careful study of the many designs of piers given by the author.

The chapter on sheds is excellent, although it is to be regretted that it was not extended to embrace more types. Pier and quay fenders, mooring posts, cleats, bits and bollards are well illustrated. That railroad tracks should not be depressed is in accordance with modern practice, but the paragraph on the location of the tracks in relation to the pier and shed cannot be approved as the best.

The chapter on cargo-handling machinery well describes the few existing machines and methods in operation in the United States, but these methods do not give results in economy and speed in comparison to those at European ports. If the United States is to compete for foreign commerce, it must not pay three times as much for freight handling as its competitors, and must not take three times as long to discharge and load vessels.

In the appendix, various data are given of the costs of structures, but in many cases no reference is made to the year of the construction, so that the prices in most cases will have to be used with care.

On the whole, it may be said that the book is satisfactory, especially that part which refers to retaining walls and superstructures.

* Consulting Terminal Engineer, New York.

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ing stringer, and a bolt is slipped through the two, so that the plank cannot shift its position. No nuts are used, and the holes in the platform planks are countersunk, to receive the heads of the bolts. A plank that is secured in this way can be taken up without any trouble.

Interior Staging

Much of the interior work, such as the erection and plating of bulkheads, is performed by means of ladders, or from scaffolds swung from deck beams or other overhead supports by means of ropes or chains, and many of the hazards incident to labor on the outside staging are also present in connection with this interior work. Moreover, the interior work must often be done from extremely awkward positions, and where there is a temptation to undertake work a little beyond the safe reaching point. The attempt to reach too far is a common cause of the falling of ladders and of workmen losing their balance. Ladders from which work is to be done should invariably be lashed, or otherwise securely fastened, both at the top and at the bottom. Even though considerable delay is involved, stagings and ladders should be adjusted to the convenience of the workman, if accidents from overreaching are to be avoided.

In view of the vast amount of work that must be done from shipyard stagings, strict supervision should be exercised over the construction and maintenance of all structures of this kind. A busy yard can ill afford to dispense with the services of a capable staging supervisor and his gang of workmen. It is certain, for example, that a competent supervisor would not permit a double-decked staging to be used without adequate overhead protection to the men on the lower level; yet scaffolds of this kind, without any protection whatever, are very commonly seen in shipyards.

In building a ship there is a certain point at which the accident rate is likely to reach a "peak," and experience shows that this occurs when the framework of the vessel is being placed. The ship is then a mere skeleton, and the men have to perform arduous work with very insecure footing. During stormy weather they are likely to lose their balance from gusts of wind; or beams or plates that are being swung into position are likely to be suddenly swerved by the wind, at great peril to the men. There does not seem to be any way to provide satisfactory safeguards in connection with this part of the work. Only the most skillful and careful men should be employed at it, and they should be set at other tasks whenever the weather conditions add materially to the hazard.

Another hard problem to deal with is the elimination of cuts and bruises and other minor injuries, which are very numerous in the aggregate. Cuts due to handling steel plates with sharp or ragged edges, and finger bruises and lacerations from hammer blows, or from punching or shearing machines, are specially common. It cannot be said that the employment of none but skilled labor constitutes a remedy, for in the main the work that produces these injuries is already in the hands of skilled workmen. The only solution appears to be to stimulate the men in every way possible to exercise personal caution.

Derricks, gantry cranes and overhead railways are employed to hoist girders, machinery and other heavy parts, and to transport them to various sections of the ship. During certain stages of shipbuilding, specially skillful handling of the crane and derrick loads is necessary if serious accidents are to be avoided. The men on the skeleton of the ship have a precarious footing at best, so that poor judgment, or a misunderstanding of signals, when lowering or swinging a load, may either cause a workman to be thrown down from his position or cause him to miss his footing in his quick endeavor to escape Here, again, is an illustration of the need of providing a competent safety man to actively supervise all operations of a dangerous character.

So far, we have dwelt mainly on accidents due to falls from staging, ladders and other elevated structures. One other source of falls must also be prominently mentioned. It would be hard to name an industry in which there are more opportunities than shipbuilding affords for falling into unprotected openings. In the modern vessel with several decks there are many openings for ventilators, bunker hatches and other permanent uses, in addition to those that are left for temporary building purposes. Unless these various openings are covered over whenever they are not actually in use, workmen and others who may have occasion to go near them are in danger. Stout wooden covers, with the edges on the upper side beveled, are excellent safeguards, and when they must be left off to admit light and air, strong wire-mesh guards may be used instead of solid wooden ones. As workmen are prone to remove covers of this kind and leave them off, it should be the duty of some one specified man to see that a sufficient number of proper covers are provided, and that they are *kept in place*.

The influence of poor illumination on the accident rate in shipbuilding has been very marked in the past, but there is evidence that lighting conditions are being rapidly improved. Formerly, a ship under construction, having no self-contained lighting plant, usually depended on gasoline torches or oil lamps, and this condition still exists in many sailing vessels and in some steamships. Explosions and fires, with resultant burns, were frequent occurrences. In addition, parts of the ship that were not much frequented were left in total darkness, while other parts were not lighted well enough to permit a maximum of efficiency and safety in the work. Of late years, the extension of lines for the transmission of electrical energy, and the installation of power houses at the shipyards themselves, have made available a very flexible source of power and light. It is a simple matter to string wires to any part of the ship and to use the particular size and type of lighting unit best suited for the space to be illuminated. Particular attention should be given to the lighting of the approaches to the ship, where large-sized lighting units, suspended well above the ground, are desirable.

Each year shows a number of serious and fatal accidents to boys of from fifteen to eighteen years of age. While serving their apprenticeships the boys are at first employed as rivet heaters, rivet catchers and markers, and in performing work of this nature they are often stationed at high elevations and in dangerous and exposed parts of the ship. The boy who heats the rivets throws them to another at some distance, who catches them in a keg or bucket and quickly places them in the holes for the riveter to drive. Speed is essential in order that the rivets may be as hot as possible when they reach the holes. It is evident that the ability of the rivet heater to throw the rivet accurately has an important bearing on the safety of the rivet catcher as well as upon that of other employees at work below. If the rivet-heater's aim is poor, the catcher must either reach out at the risk of losing his balance, or else allow the rivet to pass on with the chance of striking someone below. None except mature men should be assigned to this work, and those at work directly beneath the rivet catcher should be protected by hanging a substantial, close-meshed wire netting under the working area and moving this netting as the work progresses.

(To be concluded.)

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Letters from Marine Engineers

Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries—Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Valve Disk Troubles

Considerable trouble was experienced for several years by the breakage of stems of the metal valve disks of our Blake Knowles feed pumps, as shown in Fig. 2. Many of

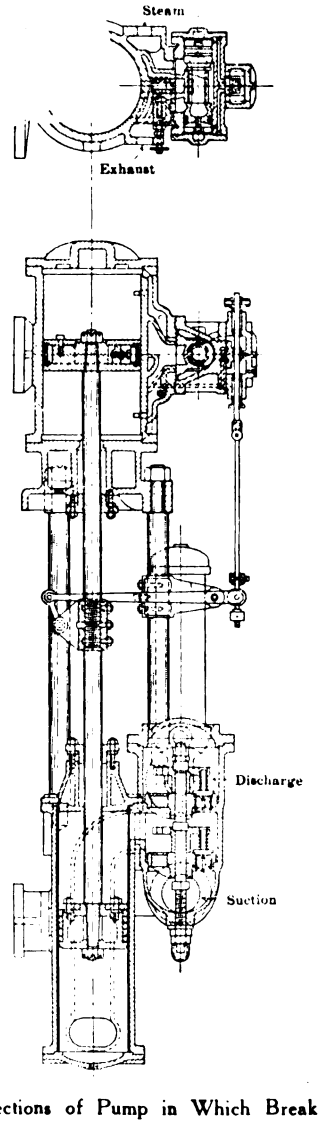

Fig. 1.—Sections of Pump in Which Break Occurred

these broken stems and loose springs caused considerable damage to the valves in the feed line.

Several schemes were tried for repairing the broken valves and to prevent further breakage of good valves, such as inceasing the radius of the fillet on the new valves where the break occurred.

Fig. 3 shows the final scheme adopted to cure this disagreeable trouble. What caused these stems to break is

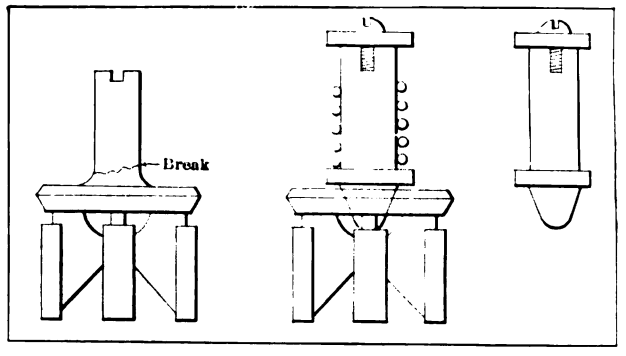

Fig. 2 Fig. 3 Fig. 4

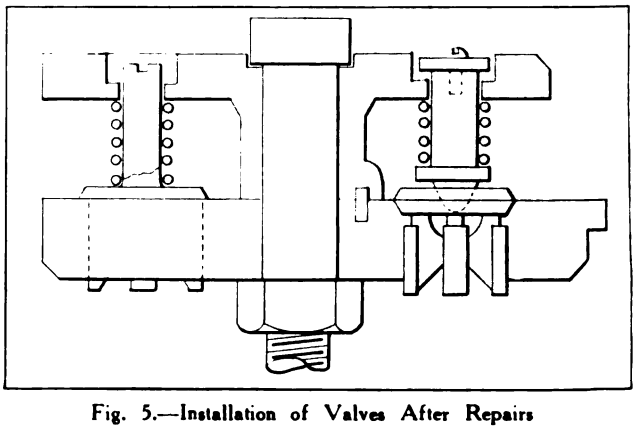

Fig. 5.—Installation of Valves After Repairs

hard to say. The writer has formed the opinion that it is when the pump slams or bucks, such as when steam bound, or when there is trouble in obtaining proper suction.

AUXILIARY.

Make Your Chance

"Gee, if I only had his chance I could have got that place!" So it goes—another fellow blames his failure to lack of chance, and is content to plod along, not attempting to even try to create an opportunity. He is one of many who attribute success to luck.

These kind of fellows are [illegible] who are always howling about square deal, favoritism. Are you one of them? If you are [illegible] Stop wishing you had the other fellow's chance and put a little steam of your own. The fellow who will [illegible] you get a chance is yourself. Stir him up a bit [illegible] your natural ability by using up some of your [illegible] which is now lying dormant. Do not be afraid [illegible] ing demands on your energy—you can't use [illegible] Pretty soon you will feel the call for bigger things [illegible] ill then realize that you are fitting yourself.

In place of lamenting about [illegible] chance and hard luck, bone up. Get a little more [illegible] warm—heat up your enthusiasm to 212 degrees [illegible] t will be self-confidence and reward commensurate [illegible] th your new ability.

Quit day dreaming and start [illegible] Look things

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Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding will be Answered in this Department

BY H. A. EVERETT *

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so. Indicator cards taken from marine engines will be carefully analyzed, the defects pointed out and the horsepower calculated, provided complete data are sent with cards.

The "Willans Line"

Q. (897).—What is the "Willans Line"? I have seen it spoken of in discussions of engine economy tests and have been unable to find any description of it in the text books which I have.

A. (897).—The Willans line is a curve obtained from water rate trials of an engine at different loads. It is a plot of the total steam used per hour (or water rate × horsepower) as ordinates on horsepowers as abscissæ. (See sketch.) In throttle-controlled engines it is, or

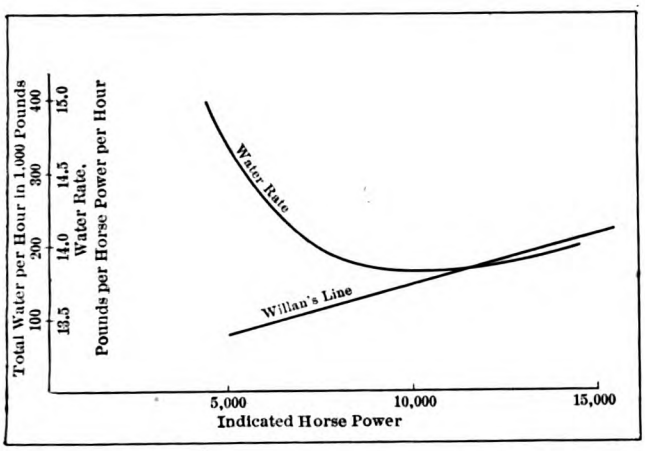

Diagram of Water Rates of Engine at Different Loads

should be, nearly a straight line and interpolation and extrapolation can be more easily made from it. Its departure from a straight line is a variation of the water rate from constancy. The points of tangency of the curve to a straight line drawn to the origin gives the most economical load. Willans law states that at fixed cut-off and varying pressure the steam consumed per hour is represented by an expression of the following form:

Total steam per hour = C. $C \times$ horsepower, where C and C are empirical constants.

Text-Books on Thermodynamics

Q. (899).—Please give me the names of some good text-books on thermodynamics.

A. (899).—Thermodynamics of the Steam Engine. By C. H. Peabody. John Wiley & Sons: New York.

Principles of Thermodynamics. By G. A. Goodenough. Henry Holt & Co.: New York.

Theory of Heat. By Thomas Preston. Macmillan Company: New York.

Technical Thermodynamics. Vols. I and II. By G. Zeuner (translated by J. F. Klein). D. Van Nostrand Company: New York.

"Dry Back" Scotch Boiler

Q. (898).—In a recent article I saw mention of a "dry-back" Scotch boiler. Can you tell me what is meant by this? Is it the same as the ordinary Scotch boiler? If not, can you give me a sketch of it?

A. (898).—In the dry-back Scotch boiler the furnace extends clear through the boiler and the combustion chamber (A) is external to the boiler, being formed by the extension of the shell and the setting at the rear of the boiler. It is rarely found in marine practice, but is common for stationary plants ashore. The figures given above illustrate the two types.

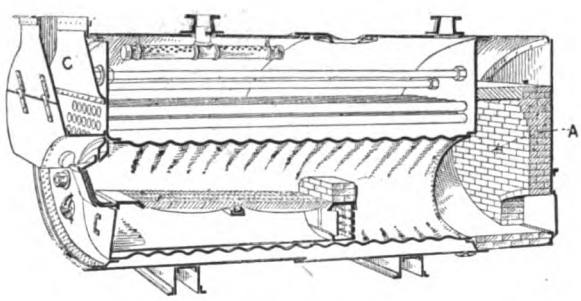

Fig. 1.—Section of Dry Back Scotch Boiler

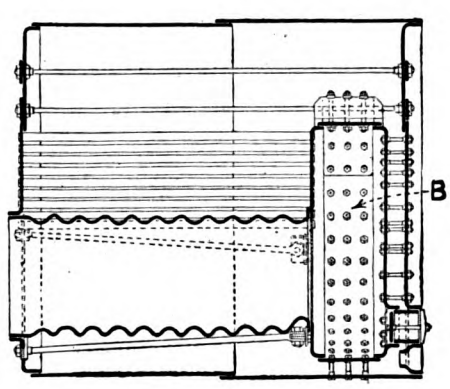

Fig. 2.—Section of Wet Back Scotch Boiler

Steam Turbines and Diesel Engines

Q. (900).—Please describe principles and operation of steam turbines and Diesel engines.

A. (900).—Your question is too broad for answer in this column. Consult "The Steam Turbine," by Robert M. Neilson, Chapter IV (Longmans Green & Co.).

* Professor of Marine Engineering, Post Graduate Department, United States Naval Academy, Annapolis, Md.

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REINFORCED CONCRETE SHIPBUILDING

Shortage of Wood Has Led French Shipbuilders to Adopt Reinforced Concrete for Ship Construction

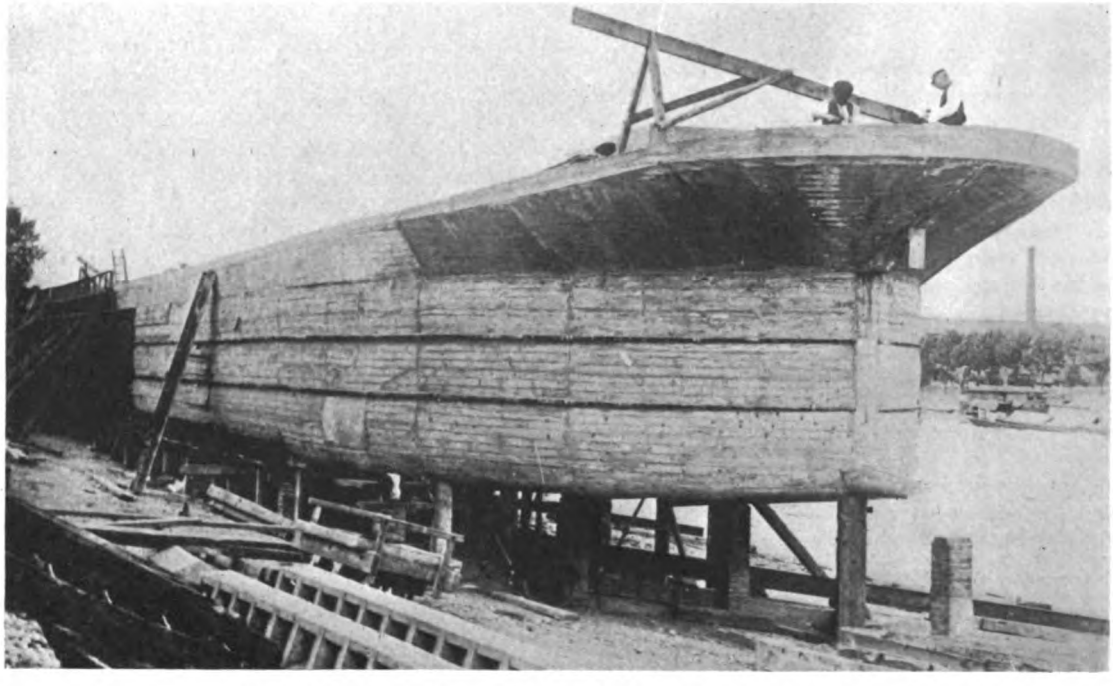

Fig. 1.—Reinforced Concrete Vessel Under Construction in France

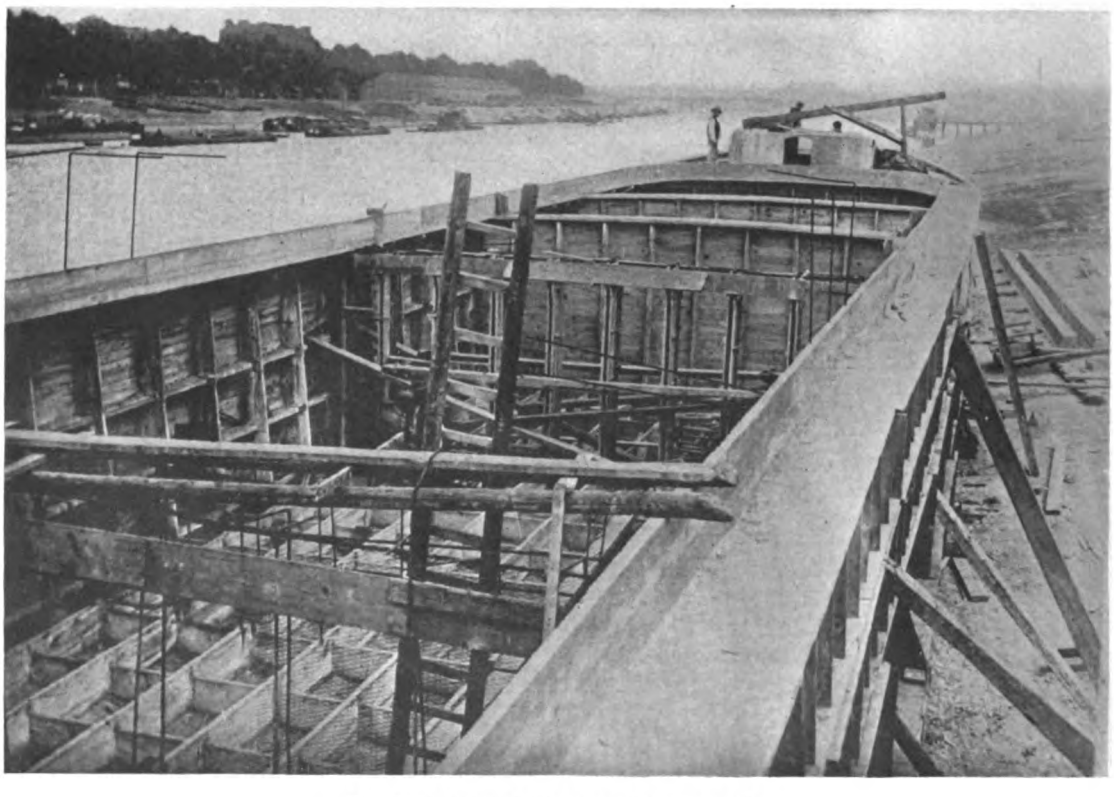

Fig. 2.—Interior of Reinforced Concrete Ship

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Shipbuilding and General Marine News

Contracts for New Ships—Shipyard Improvements—Engineering Projects—Improved Appliances—Personal Items

Vol. XXII MARINE ENGINEERING. AUGUST, 1917 No. 8

PROGRAMME TO FEDERALIZE SHIPYARDS

Statement by Gen. Goethals Outlining Method of Requisitioning Ships and Basis of Compensation

The following statement was authorized by Gen. Goethals, general manager of the United States Emergency Fleet Corporation, before his resignation:

It has been decided, after consultation with representatives of the shipyards, that the construction of steel merchant ships in all the shipyards of the United States must be hastened—

(1) By the addition of overtime where necessary,

(2) By proceeding to additional labor shifts as soon as may be, and

(3) By the elemination of non-essential refinements of construction and equipment.

It is necessary, also, that each yard increase its production to the maximum, and after the building berths are cleared of ships now under construction be devoted to producing the particular type of ship to which it is best suited.

WILL REQUISITION ALL STEEL SHIPS

Because of their varied contracts for shipbuilding, the yards cannot carry out this programme without the help of the Government; it has, therefore, been decided that the shipbuilding industry of the Nation shall be federalized. All steel merchant ships now on the building berths will be forthwith requisitioned by the United States, and each yard will proceed to complete such ships under the direction of the general manager of the United States Shipping Board Emergency Fleet Corporation, and will take on new work (other than repair work) only with his consent.

No ships under construction for the Navy Department or for any other Government department, or for the United States Shipping Board Emergency Fleet Corporation, and no ship repair work, will be requisitioned at this time.

FAIR PAYMENT ASSURED

It is the policy of the Government to make fair payments for the work done under this programme, so that investment of private funds in the shipbuilding industry may be secured, and to encourage the training of men to work in that industry.

It is essential to the success of this programme that the shipyards and the men employed in them co-operate with the Government.

The programme contemplates that the yards under their present management will hire and pay labor and continue in charge of ship construction as heretofore.

(*Concluded on page 370.*)

GOETHALS SHIPBUILDING PROGRAMME TO YIELD 5,860,000 TONS OF SHIPPING WITHIN TWO YEARS

Contracts for 525 Steel and Wood Vessels Already Let or Pending—Two Government Yards to Produce 400 Standard Steel Ships

In a letter to the chairman of the Shipping Board on July 13, Major-General George W. Goethals outlined the programme of the Emergency Fleet Corporation for building and commandeering ships in accordance with the powers recently granted by Congress. Although General Goethals' letter indicated that he was ready to start this vast programme at once, opposition from the Shipping Board has delayed the execution of these plans until the details can be thoroughly investigated.

General Goethals' statement was as follows:

SHIPS NOW BUILDING

Contracts for 348 wood ships have been let or agreed upon, with a tonnage capacity of 1,218,000 tons, at a cost completed of approximately $174,000,000.

In addition, I have under negotiation contracts for about 100 wood ships.

Contracts for 77 steel ships have been let, or agreed upon, with a tonnage of 642,800 tons, at a cost of approximately $101,660,356.

UNITED STATES SHIPPING BOARD

EMERGENCY FLEET CORPORATION

Washington

JUNE 29, 1917.

To Whom it May Concern:

As a war measure, the Government has found it necessary to adopt the policy of discouraging, * * * the publication and dissemination of information in regard to merchant marine ship construction. * * *

To conform to this policy, the United State Shipping Board Emergency Fleet Corporation hereafter will not be able to give out for publication, or other use, any information relating to the number, size and character of vessels under contract, the place where they are being built, and by whom, the percentage of completion, date of final completion, etc.

(Signed) GEO. W. GOETHALS,
General Manager.

There are thus provided 425 ships of all sorts, with an aggregate tonnage of 1,860,800, at a cost of approximately $275,000,000, besides 100 more wood ships under negotiation. I shall continue to let all contracts for wood ships (of design approved by the naval architect of the corporation) which I can secure from responsible bidders.

CONSTRUCTION OF STANDARDIZED SHIPS

My main reliance for getting the greatest amount of the most serviceable tonnage in the shortest time will be on the construction of fabricated steel ships of standard pattern. For that purpose I shall use to some extent the existing yards.

On July 16 I shall offer contracts for the building of two plants (to be owned by the Government) for the construction of fabricated steel ships, to produce 400 ships of an aggregate tonnage capacity of 2,500,000 tons within the next 17 to 24 months. For the building of these two yards and the construction of ships in them I shall offer as compensation to the agents who undertake the work a fee of approximately 6 percent of the total cost of the work, with rewards for savings on cost and for speed in delivery. Provision will be made for decreasing the fee to prevent unnecessary cost. The contracts will give the Government the benefit of Government-fixed commodity prices and will provide for cessation of work at any time, so that the appropriation may not be exceeded. Options will be given to the contractors to purchase the plants at arbitrated values on the completion of the work.

The design of the ship is ready, the plans of the yards are ready, the distribution of the work of furnishing the material and of fabrication is arranged.

This part of the programme will take all the $550,000,000 available not absorbed by contracts made or making, as stated at the beginning of this letter. The programme will more than redeem my estimates to the Congressional committee at the time this appropriation was asked for of 3,000,000 tons of new construction within 18 months.

The additional contracts for wood ships which I expect to place, together with the full number of fabricated steel ships which it is planned to build, will

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require more money than Congress has authorized. When I know how much will be needed it will be necessary to ask Congress for further sums.

COMMANDEERING OF SHIPS IN YARDS

On July 16 I shall deliver to shipbuilders a general statement of the programme which I have long been maturing for commandeering ships now under construction for private account (such ships having an aggregate tonnage considerably in excess of 1,500,000 tons).

The essence of this programme is to commandeer all such ships and expedite their construction by adding labor and cutting out refinements. By thus federalizing each yard, giving it Government help and putting it on a speed basis, we shall produce its greatest efficiency. As fast as the berths are cleared each yard will be devoted to the production of a single type of tonnage for which it is best suited. I count upon the complete co-operation of the yards.

This programme is made comprehensive because expedition cannot be obtained in a yard engaged partly on rush work and partly on pre-war time schedules. My investigation has satisfied me that citizens of the United States and of our allies will pay the cost of expediting ships now building for them, and take them off our hands. If this policy is adopted it will conserve our fund.

I agree that it is essential for the Shipping Board to requisition at once the neutral ships which are constructed and ready to sail. I have no data to make an estimate as to how many of these ships there are or how much money will be required for this purchase. I shall, therefore, cut my programme to the extent of $50,000,000. Please notify me at once whether this is enough.

Each day's delay in summer—in commandeering or contracting—means two days' loss of time in throwing the work into the winter months. It is for that reason I am urgent that the programme start on July 16.

Very truly yours,

GEORGE W. GOETHALS,
General Manager.

SHIPBUILDING CONTRACTS

Recent Orders for Merchant and Naval Vessels

The Bath Iron Works, Bath, Me., has received a contract from the Navy Department to build four torpedo boat destroyers.

The South Jersey Yacht Building Company, Atlantic City, N. J., is reported to have received a Government contract to build thirty launches at a cost of about $50,000.

The Howard E. Crook Company, 28 Light street, Baltimore, Md., which is planning to construct a shipbuilding plant, including marine ways and machine shop, is reported to have received a contract to build six wooden hulls for the United States Shipping Board Emergency Fleet Corporation.

The Traylor Engineering & Manufacturing Company, Allentown, Pa., will construct ten wooden vessels at its new shipyards at Cornwells, near Bristol, Pa., now in course of construction.

The Washington Shipbuilding Corporation, Seattle, Wash., is reported to have received a contract from the French Government to build six 2,000-ton auxiliary power wooden ships.

The Humphreys Marine Railway & Lumber Company, Weems, Va., has received a contract from Bellows & Squires, Ocran, Va., to build four oil-burning fishing steamers.

E. James Tull, Pocomoke City, Md., is building four 192-foot barges for the Diamond P. Boat Line, Philadelphia, Pa.

The Alabama Dry Dock & Shipbuilding Company, Mobile, Ala., is reported to have received a contract to build four mine sweepers and two large full-rigged ships.

Bath Iron Works Bought by Syndicate of Maine Financiers

The Bath Iron Works, Bath, Me., which has contracts from the Navy Department for nine torpedo boat destroyers to cost more than $10,000,000, has been sold by the estate of the late John S. Hyde, former president of the company, to a syndicate of Maine financiers, headed by former Governor William T. Cobb, of Rutland, chairman of the Maine Shipbuilding Committee.

Ex-Governor Cobb succeeds Mr. Hyde as president of the corporation, and the board of directors consists of Mr. Cobb, Frederick H. Appleton, of Bangor; Maynard S. Bird, Hugh J. Chisholm and Eleazer W. Clark, of Portland; Henry W. Cushman, of Bangor; Charles H. Gilman, of Portland; Weston Lewis, of Gardiner; H. M. Verrill, of Portland; H. H. McCarty, John McInnes and Charles P. Wetherbee, of Bath.

The shipbuilding plant will be enlarged to co-operate with the Navy Department in meeting the requirements of the present crisis for naval construction.

Fore River Yard Will Employ Eleven Thousand Men

Within the next three months the Fore River shipyard will increase its force of employees to 11,000. Since the declaration of war 1,200 men have been added to the working force of the yard, so that the number employed at the present time is approximately 7,500.

The importance of the rapid growth of the Fore River yard can be realized when it is known that practically one-third of the torpedo boat destroyers and over one-half of all the submarines now being built for the United States Navy are under construction at this yard.

The Moore & Scott Iron Works Becomes the Moore Shipbuilding Company

With the sale of the interests of H. J. Scott and J. J. Scott in the Moore & Scott Iron Works, of West Oakland, Cal., to J. E. and Andrew Moore, the name of the company will be changed to the Moore Shipbuilding Company, and numerous additions and improvements will be made in the company's plant.

The new firm will expend $1,500,000 on improvements, and when the additions have been made the plant will occupy about 44 acres of land. The yard is at present building eight large vessels, and the new management expects to receive contracts for a large number of Government merchant vessels.

Rear-Admiral D. W. Taylor Receives Franklin Medal

At a meeting of the Franklin Institute, Philadelphia, Pa., on May 16, the Franklin Medal was presented to Rear-Admiral David Watson Taylor, U. S. N., chief of the Bureau of Construction and Repair. Upon this occasion Rear-Admiral Taylor delivered an address on the "Science of Naval Architecture."

To Federalize Shipyards

(*Concluded from page 369.*)

For work done in carrying out this programme the yards will be compensated on the following general basis:

BASIS OF COMPENSATION

(A) For work on ships now under construction the yard will continue to furnish, at its own expense, the labor and all materials (so far as not now on hand) necessary to complete the ships, and will be entitled to hold for its own account all payments heretofore made under the construction contracts, and to receive from the Government the balance of the contract prices on the dates and conditions provided in the contracts (with the following modifications):

1. The prices paid will be minus amount saved by elimination of non-essential refinements and plus additional expense of changes in specifications determined upon by the general manager.

2. In the event of any increase in the scale of wages at the yard after the date of federalization, such increase will be paid by the Government if it is found to be justifiable and is approved by the general manager.

3. The Government will pay the overtime allowance (over yard basis) on the cost of direct labor on any ship (or will adopt some other equitable basis as to the overtime expense).

4. In case the yard adds an extra shift it will receive a suitable allowance to cover the extra cost due to lower efficiency of night work under these conditions.

(B) For construction of new ships the Government will pay—

1. Approved material costs (the Government reserving the right to furnish materials).

2. Direct labor cost.

3. An additional sum to include other costs and a fair profit.

All moneys due the yards, except as herein otherwise provided, will be paid in instalments hereafter fixed.

Direct labor cost will be exactly defined.

Arrangements for adjusting the payments already made to the yards by ship purchasers will be made by the Government.

Federalization of yards will end within six months after peace (subject to completion of ships under way).

GOVERNMENT MAY FURNISH FUNDS

If necessity arises, the Government, from time to time, may furnish sums, to be hereafter fixed, for plant and equipment, including the erection of laborers' houses and accommodations (to remain the property of and the income thereof to be received by the Government), on such terms and at such times as may be arranged.

Orders will be issued as soon as may be to each yard separately defining the application of this programme to the particular yard.

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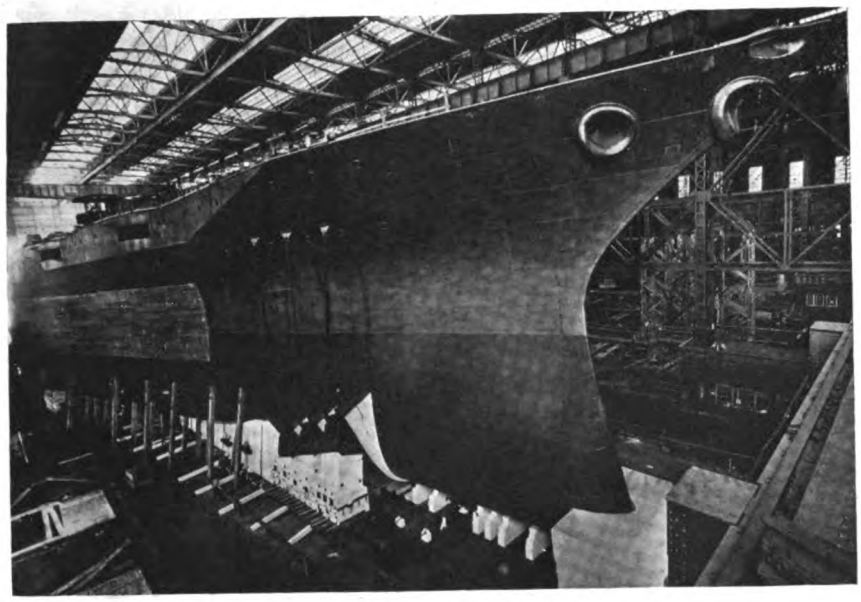

Battleship *Idaho* Ready for Launching

Battleship Idaho Launched at Camden

Contrary to the usual custom in times of peace, the latest United States battleship to leave the builders' ways was launched in the presence of only a comparatively few spectators. This was the superdreadnought *Idaho*, building at the New York Shipbuilding Corporation, Camden, N. J., which was launched on June 30, and christened by Miss Henrietta Amelia Simons, the 14-year-old granddaughter of Governor Alexander of Idaho.

The *Idaho* is 624 feet long, 97 feet 4½ inches extreme beam, 30 feet mean draft and 32,000 tons displacement. She is armed with twelve 14-inch guns, twenty-two 5-inch, four 3-pounders, four anti-air craft guns and two torpedo tubes. Her complement consists of 56 officers and 1,141 men.

The *Idaho* is a sister ship of the *Mississippi*, recently launched by the Newport News Shipbuilding & Dry Dock Company, and the *New Mexico*, recently launched by the New York Navy Yard. The keel of the *Idaho* was laid on January 19, 1915, and when launched she was about 70 percent complete.

Dates Announced for 1918 National Motor Boat Show

"Big business during the war and bigger business afterward" is the summing up of conditions in the motor boat industry, as expressed by Henry R. Sutphen, chairman of the Exhibition Committee of the National Association of Engine and Boat Manufacturers, in announcing the dates for the 1918 National Motor Boat Show.

The coming show will be the fourteenth annual exhibition under the auspices of this association, and will be held in Grand Central Palace, New York City, opening on Saturday, January 19, and closing on Saturday, January 26. A complete exposition of all the newest types of motor boats, together with latest advanced designs in marine engines and motor boat fittings, will serve to attract many thousands of visitors.

Crandall Marine Railway Installed in New Shipyard at Norfolk, Va.

A new Crandall marine railway of 1,000 tons capacity has recently been completed at the new shipyard of the Southern Transportation Company at Norfolk, Va. The cradle, equipped with patent releasing bilge blocks, is 225 feet long, and is designed especially for barges and towboats.

The railway was designed and built by the Crandall Engineering Company, Boston, Mass., and was put in operation ten weeks after the driving of the first pile. It is electrically operated and has sufficient power to haul a 1,000-ton load in twenty minutes.

New Crandall Railway Dry Dock at Norfolk

SHIPYARD IMPROVEMENTS AND EXTENSIONS

Progress of Work in Enlarging Shipbuilding Plants

The William Cramp & Sons Ship & Engine Building Company, Philadelphia, Pa., has acquired property at Beach and Palmer streets for extensions to its works.

The American Bridge Company, Trenton, N. J., is reported to be planning for extensions in its local plant to cost about $1,000,000, for the construction of steel barges and vessels of other type. The company's plant at South Trenton has recently been constructing boats of this nature for the Lehigh Valley Railroad, averaging in size about 40 feet wide by 265 feet long.

Seven days after receiving a Government contract for 16 wooden ships the Sloan shipyard at Olympia laid the keels of the first two. This plant already had four 3,200-ton motor ships under construction, and is building ways to lay down two more of the Government ships. The Sloan people recently started enlarging their plant, and will soon be making their auxiliaries in their own machine shop.

The proposed new plant of the Baltimore Dry Docks & Shipbuilding Company, Baltimore, Md., at Spring Gardens, opposite its present plant at Locust Point, will consist of the following buildings: Fabricating shop, 100 by 400 feet; boiler shop, 110 by 340 feet; ship shop, 60 by 340 feet; assembly shop, 80 by 400 feet; layout shop, 60 by 350 feet, and several minor structures, with four new shipbuilding berths. The plant is estimated to cost $3,000,000. Contract for construction of buildings has been awarded to the Belmont Iron Works, Philadelphia.

The Union Iron Works, San Francisco, is planning to spend $2,000,000 for improvements.

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NEW SHIPYARDS UNDER CONSTRUCTION

Contracts Placed for Large Shipbuilding and Repair Plants

The Downey Shipbuilding Corporation, 120 Broadway, New York, has commenced active work in the construction of its proposed new shipbuilding plant at Milliken, S. I. The shipyards will be operated in connection with the steel works of Milliken Bros., Inc., at this location. Six shipbuilding berths will be constructed.

The New Jersey Shipbuilding Company, Gloucester City, N. J., recently incorporated, with a capital of $1,000,000, has commenced the construction of its proposed new shipbuilding plant on property adjoining the plant of the Pennsylvania Shipbuilding Company, with which the company is said to be affiliated. The initial works will consist of machine shops, one and two-story; boiler works, joiner and forge shop, plate and angle shop, riveting shop and other structures.

E. W. Heath, of Seattle, is superintending the construction of the plant of the Tacoma Shipyards Company. This company is preparing the ways for six wooden ships and is putting up a 52 by 216-foot two-story machine shop and mold loft and other buildings.

The Patterson-MacDonald Company has let the contract for the building of a machine shop, mold loft, store house, office building and a sawmill on a 25-acre site on the Duamish Waterway at Seattle. This company has a contract to build ten wooden ships, and will build six ways.

Ship Fitters Wanted at Navy Yards

In spite of the fact that the civilian mechanical forces at navy yards and other naval establishments has been increased since April 1 from 25,000 to about 35,000 men, the United States Civil Service Commission in Washington has sent out notice that there is urgent need in the government service of qualified ship fitters at navy yards who will be paid from $4.24 to $4.48 a day.

Practical journeyman boiler makers, who have had experience in laying out work from drawings or blue prints, will be appointed ship fitters, and will be given every opportunity to demonstrate their ability. Applications may be filed at Room 318, Custom House, New York, or with the Civil Service Commission, Washington.

SKINNER & EDDY SHIPYARD RAPIDLY GROWING

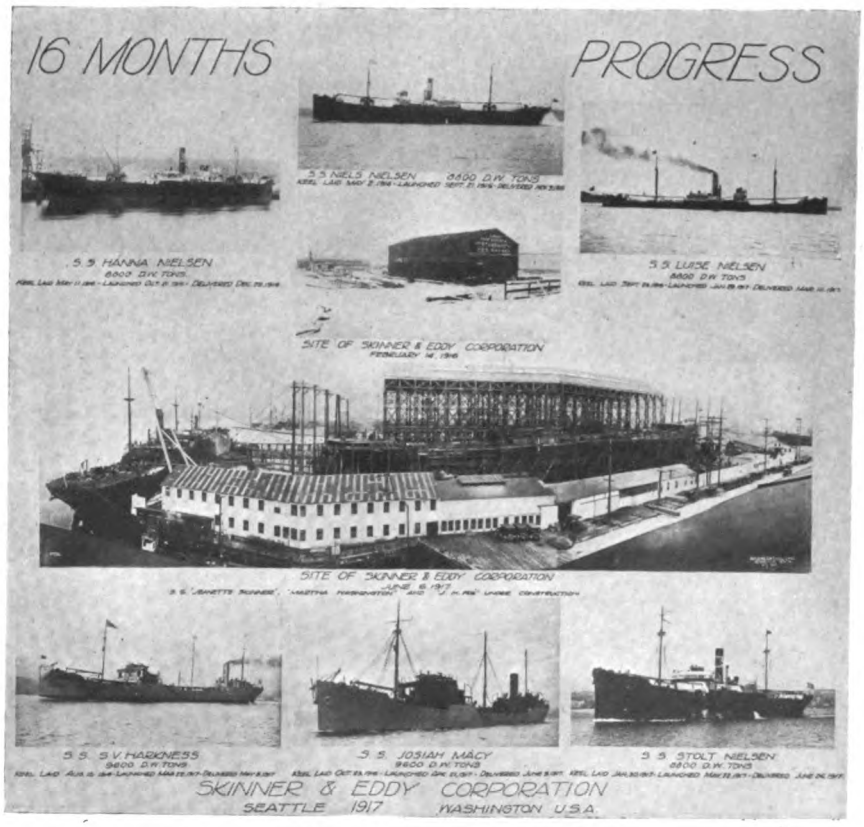
Adjoining Property Recently Added to the Plant

Sixteen months' progress at the Skinner & Eddy shipyard, Seattle, Wash., is depicted in the photograph reproduced below. The progress shown was accomplished on three building slips, one of which was added after the plant was well under way.

To make room for two more building slips, which will soon be completed, and on which the ships building under Government contract will be constructed, the company recently acquired the adjacent property occupied by the Hofius Steel & Equipment Company and the Continental Mill. This new addition will increase the acreage of the yard to approximately 25 acres.

To show how the operation of the yard is constantly becoming more efficient under the guidance of Dave Rodgers, the plant manager, who, in a large measure, has been responsible for its success, it may be mentioned that the last ship launched, the *Jeanette Skinner*, remained on the ways just three months and three days, or seventy-eight working days, after the keel was laid. This clips nineteen days from the previous record made in building the steamship *Stolt Nielsen*.

Dave Rodgers, Works Manager of the Skinner & Eddy Shipbuilding Plant



Pictorial Record of 16 Months' Progress at Skinner & Eddy Yard

Werkspoor Diesel Engine to Be Built on the Pacific Coast

The Skandia Pacific Oil Engine Company, San Francisco, Cal., has bought the exclusive manufacturing rights for the Pacific Coast of the Werkspoor Diesel engine. This engine is suitable for vessels up to 7,000 tons capacity, and can be made in units up to 3,000 horsepower.

The Skandia Pacific Oil Engine Company will still continue to manufacture their well-known Skandia semi-Diesel engines in sizes up to 350 horsepower. The Skandia Engineering Company, 101 Grand Trunk Dock, Seattle, are the Northwestern representatives for both the Werkspoor and Skandia engines.

Chicago Marine Repair Shops Combine Under One Management

Announcement was made on June 1 of the combining of the interests and services of A. F. Mitchell & Son, electric boiler welders; G. Brading Boiler Repair Shop, A. E. Clark Electric Repair Shop for motors, generators and electric signaling systems, and E. G. Todt Marine Engine Repair Shop, with the Kraft Shipyard & Dry Dock at Ninety-fourth street and Calumet River in South Chicago. The Kraft Shipyard & Dry Dock is strictly a repair yard, and the enlarged facilities made possible by this union of interests, along with the increased shop equipment recently installed, means an efficient organization for ship repair work on the Great Lakes, exclusive of dry dock work.

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SHIPBUILDING COMPANIES INCORPORATED OR PROJECTED

The Kingston Shipbuilding Corporation, Kingston, N. Y., has been incorporated, with a capital of $500,000, to operate a local shipbuilding plant.

The International Navigation Company, Wilmington, Del., is planning for the construction of a new shipbuilding plant at Wilmington, N. C. The proposed works will be equipped to manufacture wooden vessels of 3,000-ton capacity and 5,000 to 10,000-ton steel vessels. It is said that the plant will cost about $5,000,000.

The New Jersey Shipbuilding & Dredging Company, Jersey City, N. J., has been incorporated, with a capital of $500,000, to operate a local plant.

The Cambria Steel Company, Johnstown, Pa., is reported to be planning for the construction of a shipbuilding plant near Savannah, Ga.

The Hollywood Shipbuilding Company has been organized in Oakland, Cal., with a capital stock of $1,500,000. It is understood that the company has contracts from the Shipping Board for the construction of six steel ships.

The Ampco Shipbuilding Company, Milwaukee, Wis., has filed articles of incorporation in Delaware, with capital of $1,000,000, to operate a local plant.

E. L. Bloxom, Newport News, Va., has organized a company to build and operate a local plant for the manufacture of vessels of small type.

The Terry Shipbuilding Corporation, New York City, recently incorporated, is reported to have acquired a site consisting of about 100 acres on the Savannah River, near Savannah, Ga., for a large shipbuilding plant. It is said that the proposed plant will be equipped for the construction of all-steel and wooden vessels, with shipways for twenty ships. Edward F. Terry, president of the Terry & Tench Company, Grand Central Terminal, New York, is president and general manager of the new organization.

The United States Maritime Corporation has been incorporated by Thomas Hampton, 502 Union Savings Bank building, Washington, D. C., and associates, with a capital of $2,500,000, to build and operate a shipbuilding plant near Brunswick, Ga. The company has secured a site of about 100 acres on the Rack River, with 2,000 feet water frontage, and will build a plant with initial capacity of about twelve vessels a year. The works are estimated to cost $200,000.

The Jahncke Shipbuilding Company, recently organized, with a capital of $50,000, has acquired the St. Tammany Ship Yards, near Mandeville, La.

The Pacific Shipbuilding Company has been incorporated at Seattle, and has purchased a 15-acre site on the Duamish Waterway. They will engage in wood ship construction.

(Copyright by International Film Service, N. Y.)

British Transport Torpedoed in the Mediterranean

George A. Gilchrist, Thomaston, Me., has acquired the old O'Brien shipyard, with the intention of building wooden vessels.

The L. M. Danzler Lumber Company, Moss Point, Miss., is planning the construction of a shipbuilding plant on the East Pascagoula River.

The Freeport Shipbuilding Company has been organized at Freeport, Me., with a capital stock of $100,000.

The Lilley-Fletcher Shipbuilding Company has been organized in Los Angeles, Cal., to engage in the wooden shipbuilding business. Their temporary address is care of Henry A. Coit, Marsh-Strong building, Los Angeles. Martin C. Erismann is the naval architect and engineer in charge of the work.

The Beaumont Shipbuilding & Dry Dock Company has been organized at Beaumont, Tex.

The Midland Contracting Company, Midland building, Kansas City, Mo., is planning to build a shipyard at Houston, Tex.

(Copyright by Press Illustrating Service, Inc., N. Y.)

Wooden Shipyard on Pacific Coast

Thirty Million Dollars to Be Expended for Naval Improvements at Norfolk

Within the next two years the Navy Department will expend about $30,000,000 for the improvement of the Norfolk Navy Yard and the establishment of a new naval base on the recently-acquired site of the Jamestown Exposition.

Of this amount, $20,000,000 will be spent on the navy yard, where a machine shop, designed to be the largest in America, costing $4,000,000, covering 5 acres of floor space, will be built, together with a structural shop with tools and equipment to cost $2,000,000, a power plant, costing $1,500,000, a dry dock, costing $5,500,000, and various auxiliary buildings.

One million dollars will be spent for the improvement of the water front at the present navy yard.

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Continuous Photo-Printing Machine Widely Used in Shipyards

Every navy yard in the United States, and many of the larger private shipbuilding yards, is using a continuous photo-printing machine manufactured by the C. F. Pease Company, 213 Institute Place, Chicago, Ill. This machine is used in conjunction with an automatic washing and drying machine, manufactured by the same company, both machines being sold under the trade name "Peerless." With these machines a single operator can print, wash and dry 100 linear yards of blue prints per hour, during which time the apparatus consumes 7 units of electrical energy, 60 gallons of water and 50 cubic feet of gas. The prints can be made on separate sheets of sensitized paper, instead of in continuous rolls, if desired.

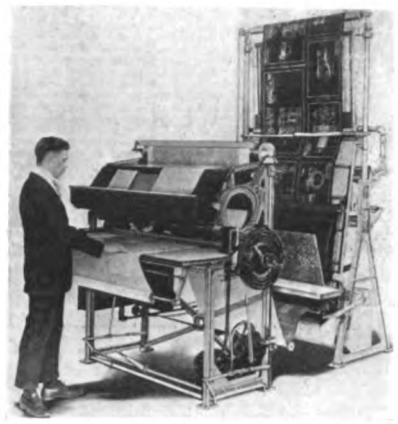


Fig. 1.—Front View

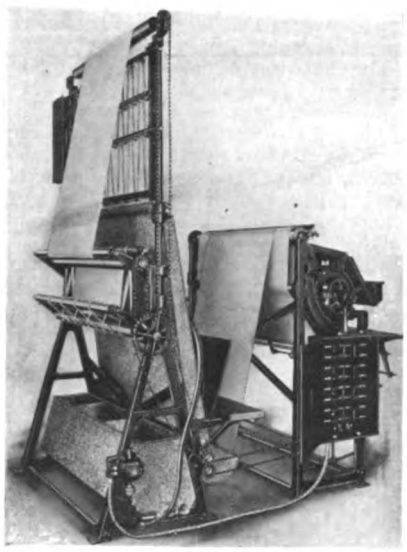


Fig. 2.—Side View

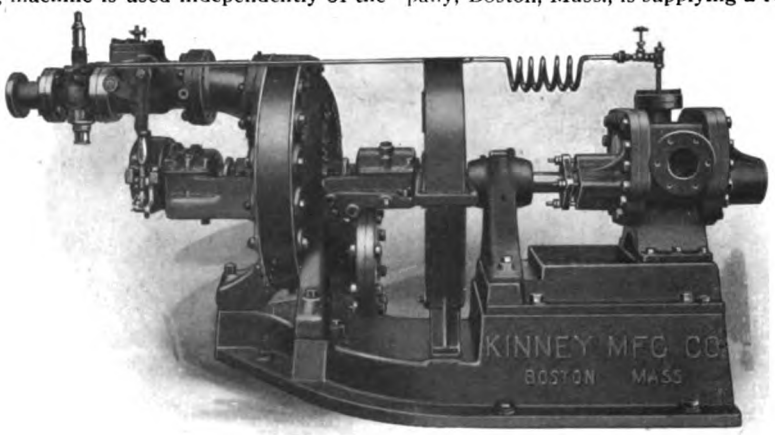
Fig. 1 is a front view of the machines, and Fig. 2 is a side view, showing the course of the paper through the apparatus. The tracings and paper are carried upwards over a cylindrical segment of thick plate glass by means of an endless canvas belt, driven by a small electric motor and kept in tight contact by means of springs. In front of the glass is a bank of five arc lamps of the inclosed type fitted with aluminum reflectors. The number of lamps employed can be varied according to the width of paper used. A small electric fan drives a current of air through the machine in order to carry away the heat from the lamps.

After being printed the tracings are delivered into an iron trough in front of the machine, so that the operator can remove them without changing his position. This trough also serves to catch the exposed sensitive paper if the printing machine is used independently of the washing and drying equipment. Usually, however, the exposed paper passes over a roll at the top of the printing machine and thence to the washing and drying machine, as shown in Fig. 2. This part of the apparatus is driven by chains and sprocket wheels from the motor of the printing machine. The drying apparatus, shown in Fig. 1, consists of a number of Bunsen gas burners, but in the apparatus shown in Fig. 2 the drying is effected by electrically-heated resistance wires, the energy consumed for this purpose being about 8 kilowatts per hour

The floor space occupied by the whole apparatus is about 5 feet 6 inches by 6 feet 6 inches. It is said to be noiseless in action and to work cleanly, so that it can be placed in the most convenient position in the drawing office or tracing room.

Rotating Plunger Pump Eliminates Trouble with Brick Work of Oil-Fired Boilers

Since the introduction of oil for fuel on board ship trouble has been experienced in the damaging of baffle plates and other brick work in the furnaces. This has been caused, it is claimed, by the uneven flow of oil to the burners, due to the impulses created by the use of plunger pumps. To overcome this trouble, the Kinney Manufacturing Company, Boston, Mass., is supplying a rotating plunger pump, from which the supply of oil is smooth, continuous and uniform, the effect of the impelling force being without pulsation.



Kinney Rotary Plunger Pump

The illustration shows a Kinney turbine-driven fuel oil pump for the battleship *New Mexico*. This same type of pump, with drive, is also to be used on the battleships *Tennessee, California, Washington, West Virginia, Colorado* and *Maryland*, and also on the battle cruisers Nos. 45 to 49. Another use for this type of pump is also found on the above-named ships for supplying lubricating oil. Fuel and lubricating oil and main and trim ballast pumps of this type are also used on submarines, and two cargo pumps of 3,000 gallons capacity per minute each are installed on tank ship No. 16.

Oxy-Acetylene Torch Cuts Off Rivets or Staybolts Flush with Plate

For cutting off rivet heads and staybolts flush with plates, by the oxy-acetylene process, it is desirable to have a cutting tip so designed as to permit of the gas jet playing parallel with the plates. To meet this need The Prest-O-Lite Company, Inc., Indianapolis, Ind., is manufacturing the special rivet and staybolt cutting attachment illustrated. The copper tip is bent at a convenient angle and is adjustable to any position, facilitating operation in close quarters.

Rivet Cutting Torch

Leather Substitute Found for Ship Upholstery

Owing to the immense amount of leather now required by the Government for war purposes in the manufacture of shoes, saddles, harness, puttees and other articles, it has become necessary to find a satisfactory substitute for leather for many manufacturing purposes. For ship upholstery, where leather is not absolutely necessary, the United States standard adopted is Du Pont "Fabrikoid" Craftsman, quality No. 1, manufactured by E. I. Du Pont de Nemours & Co., Wilmington, Del.

This material has several essential qualities that are absolutely necessary in ship upholstery, among them being its mildew, mould and water-proofness. It saves all the waste usually lost in cutting out imperfections and irregular edges of leather, as well as the expert labor which is necessary to do such cutting. It is uniform in thickness, strength and quality, it fits in perfectly with the Govern-

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ment's plans for standardization, and is material which has been used on many private boats, yachts and launches. It is appropriate for cushions and other incidental furnishings as well as upholstered parts of the ship.

Large Vertical Plate Bending Rolls Built by Southwark Foundry & Machine Co.

The Southwark Foundry & Machine Company, Philadelphia, Pa., is placing on the market a machine consisting of a vertical set of heavy bending rolls for marine boiler plate. The machine weighs 210,000 pounds, and consists of three vertical rolls, the main or center roll being 30 inches diameter and the two back rolls each 22 inches diameter, supported on a special type of bearings manufactured by the Standard Roller Bearing Company, underneath which, in a pit below the floor line, is the complete driving mechanism.

The screw-down mechanism of the main roll, which is operated by a motor separate from the main driving apparatus, is so arranged that it can be disconnected, allowing the main roll to be thrown out of parallel with the two back rolls for inserting or removing the plates which are to be rolled.

Acorn Dies and Holders Prove Accurate and Adaptable

For a successful threading die not only must a high degree of accuracy and exactness of adjustment be obtained but the tools must of of ample strength, easy to sharpen and readily adaptable to various classes of work. To meet these requirements the Greenfield Tap & Die Corporation, Greenfield, Mass., is manufacturing the Acorn die and holder shown in Figs. 1 and 2.

The lands of the Acorn die are short and wide, so that they will not only be strong but will also have no tendency to twist. The necessary radial movement of the lands is assisted by thinning the section immediately back of the thread,

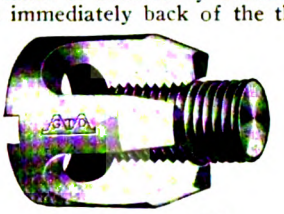


Fig. 1.—Acorn Die

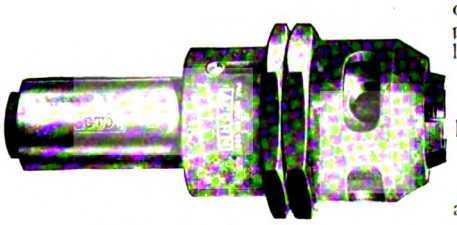
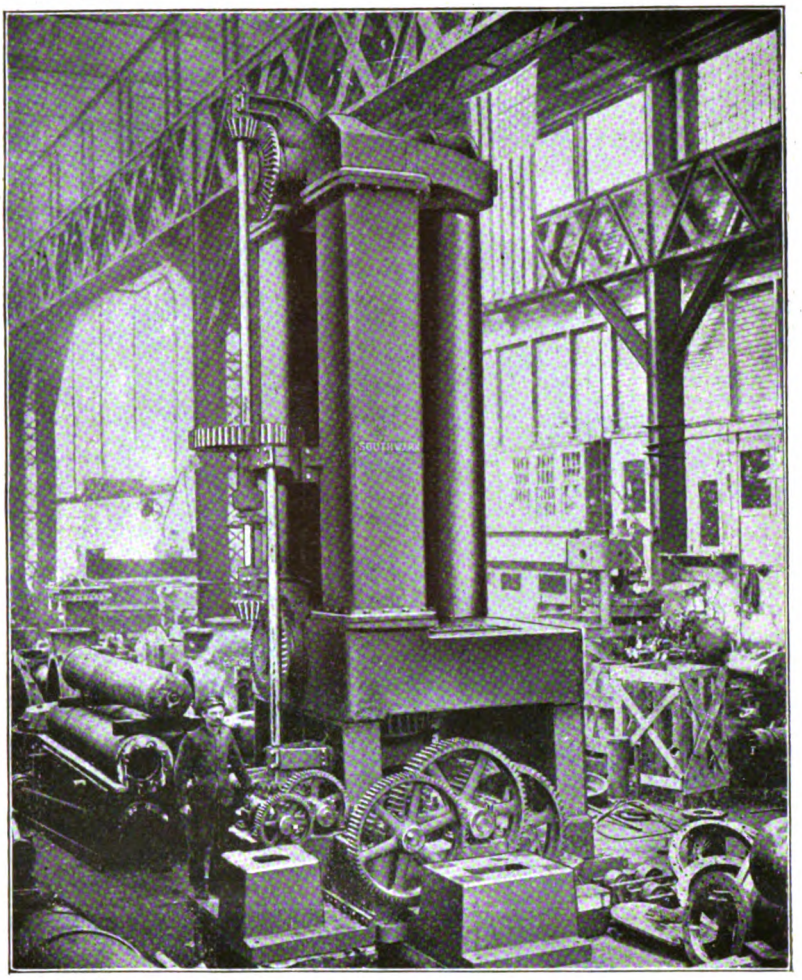


Fig. 2.—Acorn Die Holder

but increasing the width of the prongs at this point makes them uniformly strong and prevents torsional displacement. The base of the die and its seat on the body are ground flat and true to insure preserving absolute alinement when changing dies or when replacing them after sharpening. Notches on the base of the die register with dowels on the body, securing a positive drive.



Vertical Plate Bending Rolls Built by Southwark Foundry & Machine Company

The die is secured to the holder by an adjustable cap, which fits over the die and is threaded on the body below the die seat with a thread of larger diameter. This construction, it is claimed, prevents springing or other accidental misalinement. Slots in the walls of the cap permit the exit of chips that may collect inside the base of the die, and projecting the lands beyond the cap permits the heavier chips cut at this point to fall free of the holder. The nose of each large prong is beveled to conform to a corresponding bevel on the inside of the adjusting cap. The beveled surfaces of both die and cap are ground, assuring perfect contact with the bevels and a high degree of accuracy and adjustment.

National Nautical Training Association Organized

In accordance with a resolution passed at a recent meeting of the National Marine League in New York, a meeting of a committee on organization of a nautical training schoolship system has been held and a permanent organization formed, which will be under the direction of Commander J. W. Miller, to provide for the training of young men as officers for the future American merchant marine.

Plans of the permanent organization provide for giving every assistance possible to the navy at the present time, and for the permanent establishment with State and national co-operation of nautical training schools all over the country.

Three Officers from Government Training Schools Appointed for Merchant Marine Service

The first officers obtained for the new merchant marine by the recruiting service of the United States Shipping Board, whose headquarters are at the Custom House, Boston, Mass., passed examinations before the Steamboat Inspectors in Boston on July 17, and immediately proceeded to New York to take places as third mates on ships now short of officers. The successful candidates were Waite H. Patten, of Malden, Mass.; James M. Earle, Quincy, Mass., and William A. Newell, Boston, Mass. These men are all graduates of the Government school which is being conducted at the Massachusetts Institute of Technology.

Shipbuilding to be Taught at Lehigh University

Lehigh University at South Bethlehem, Pa., will offer next September a course in shipbuilding and ocean transportation in connection with the engineering department of the University. Prof. F. P. McKibben, head of the department of civil engineering, will have charge of the new course.

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SELECTED MARINE PATENTS

The publication in this column of a patent specification does not necessarily imply editorial commendation.

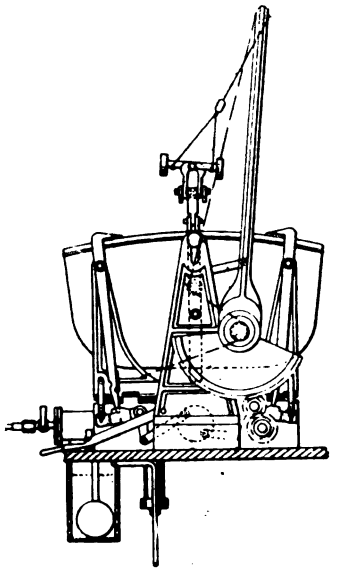
American patents, compiled by Delbert H. Decker, Esq., registered patent attorney, Millerton, N. Y.

1,210,374. HULL FOR FLYING BOATS. GLENN H. CURTIS, OF BUFFALO, N. Y.

Claim 1.—In a hull for flying boats, a V-shaped hydroplaning bottom, and a forwardly located longitudinally uniform thickness in lateral extension of the V-sides of said bottom. Twenty-one claims.

1,210,530. DAVIT AND MEANS FOR HOLDING AND RELEASING SHIPS' BOATS, RAFTS, AND THE LIKE. GERARD JOHN PHILLIPS AND LOUIS ANTHONY KELLER, OF SYDNEY, NEW SOUTH WALES, AUSTRALIA.

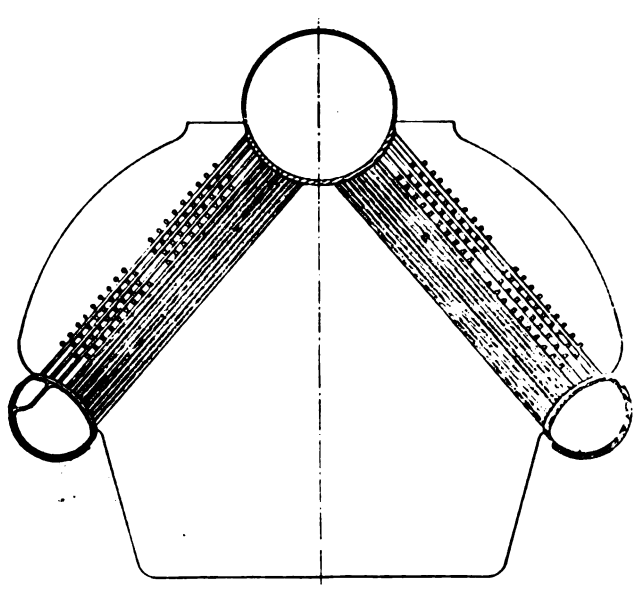
Claim 1.—In means for holding and releasing boats on board ships, the combination of boat holding side frames or chocks adapted to be displaced so as to release the boat davits, means adapted to suspend



the boat from the davits, means for pivotally supporting the boat at the bow and stern independently of said frames or chocks and suspending means when held in the side frames or chocks and means for putting out of action the said supporting means. Nineteen claims.

1,210,976. WATER-TUBE BOILER. CHARLES ALGERNON PARSONS, OF NEWCASTLE-UPON-TYNE, AND STANLEY SMITH COOK, OF WALLSEND, ENGLAND; SAID COOK ASSIGNOR TO SAID PARSONS.

Claim 1.—In a water-tube boiler of A form having a steam drum, and two water drums all arranged triangularly with their axes sub-

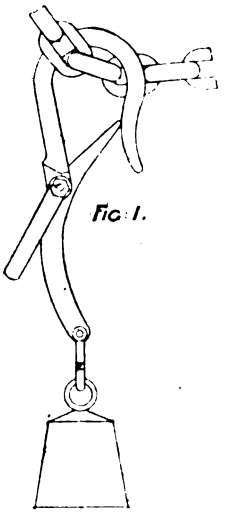


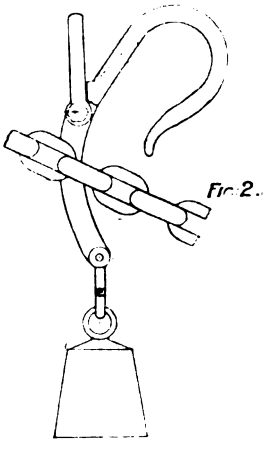
stantially horizontal and rows of upwardly convergent straight water-tubes extending between the water drums and the steam drum, and with the fire space between the convergent water-tubes, which are closely spaced apart adjacent the fire space, the combination therewith of a plurality of rows of superheater tubes in single layers intermeshed with single layers of water-tubes out beyond the closely-spaced water-tubes, the superheater tubes of each row being axially parallel with the axes of the drums and spaced apart for the passage of the hot gases laterally between them at different heights as received between the water-tubes at different levels, and located in close proximity to the water-tubes for the transfer of heat to the latter, said superheater tubes being arranged in groups with spaces between the groups for the escape of the hot gases laterally of the tubes, said lateral escape spaces lying toward the outside of and at a point intermediate the length of the bank of closely spaced water-tubes and parallel with the axes of the drums. Four claims.

British patents compiled by G. F. Redfern & Co., chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 10 Gray's Inn place, W. C., London.

103,754. MEANS FOR MOORINGG SHIPS AND BOATS. W. E. POTTER, OF 11 PAKENHAM ROAD, BIRMINGHAM.

This invention is for the better protection of life and property at sea and provides weighting means for application to anchoring cables of ships and boats lying at anchor. Fig. 1 shows an elevation of the weighting means hanging from the cable by the hook. Fig. 2 shows a similar view of said weighting means hanging from the handle before applied to the cable. The hook is adapted for hanging on the cable. To the shank of the hook is pivoted a lever and handle. The arms of the lever are so shaped with reference to the pivoting point

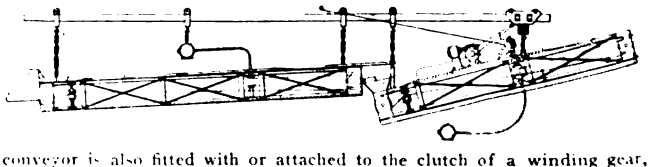




that the weight attached to the lower end of the lever by a shackle automatically rocks said lever to two positions, dependent upon whether the weighting means hangs from the hook or from the handle, causing the short arm of the lever to close or open the entrance or mouth to the hook. Fig. 1 shows the entrance closed by the short arm of said lever, for the reason that the weight hangs from the throat of the hook engaging the cable, and Fig. 2 shows said entrance open, for the reason that the weight is hanging from the handle. It will be quite clear from the drawings that so long as the weighting means is carried by the handle the entrance to the hook is open, but immediately said means hangs from the hook the short arm of the lever will close the entrance. In lowering the weighting means into position down the cable towards the anchor, a hand line or rope is attached to the shackle and paid out from the vessel to the desired length, which line or rope is used for drawing up the weighting means again when it is desired to remove it from the cable.

102,831/16. RELATING TO CONVEYORS FOR COALING SHIPS AND OTHER SUCH PURPOSES. G. JONES, OF 25 CHURCH ROAD, MANOR PARK, ESSEX.

The improved appliance consists of a framework in sections, each carrying an endless conveyor and adapted to be detachably secured, say, to the structure supporting the deck head. Each frame also carries one or more electric motors, and one of these which drives a



conveyor is also fitted with or attached to the clutch of a winding gear, capable of shifting the conveyor lengthwise. Another motor which is of the automatically reversible type is capable of swinging the conveyor laterally. At or about the delivery end of the conveyor is provided mechanism adapted to put one or more electric switches into or out of circuit. This mechanism is actuated by pressure of the coal or other material already delivered and is so designed that when a sufficient quantity has been discharged it will press upon the mechanism and close the circuits, thus operating the winding gears and thereby automatically shifting the conveyor until the pressure is released and the switches are opened, the process being repeated as often as the deposited pile of coal or other material reaches the mechanism and operates it. Other conveyors can be employed between the elevator or other means of supply so as to discharge upon one of the first mentioned conveyors. All the conveyors are transportable and may be secured by any convenient means such as stays, clamps, cables or other anchoring devices.

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